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What the Employer of Apprentices Expects of the Vocational School

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PEOPLE frequently have strong convictions about work other than their own. Apparently, few can watch another's labor without being tempted to suggest a way to do it better. Citizens give advice to the mayor, fire and police departments, and other public officials. Editors of newspapers receive no end of direction from subscribers. And what sleeping-car passenger who is jolted out of his dreams by sudden stopping and starting of the train, is not absolutely certain that if he were in the cab of the locomotive, the motion of the train would be smoother.

Usually, opinions of this kind are based on one side of a question only; the critics would think differently if they understood the entire situation. However, criticism of the kind is frequently valuable, even when unreasonable, because it enables the mayor, the newspaper editors, and the rest of them, to appreciate viewpoints not understood before and to act accordingly.

In a similar way, employers, especially employers of apprentices, have certain ideas regarding the job of vocational education. They expect certain things. Whether they have the right to expect them is another matter. Education is different from business. The employer is not an educator and is not familiar with all the phases of education. Perhaps he expects too much.

Occupational Information

However, officials and instructors of vocational schools frequently approach industry for suggestions, and this makes employers feel that schoolmen are eager to receive ideas from the outside.

The following then, are a few ideas which the employer of apprentices makes to the instructor of apprentices. First, the subjects taught in the vocational school should be determined very largely by the industries and occupations of the city. One of the primary functions of the vocational school is to provide its students with facilities and personal direction in the choice of an occupation. If there are 30,000 minors in a city, less than 5,000 of them will ordinarily be found in high schools and colleges. The remaining 25,000 eventually find their way into industrial work. The majority of them will remain in the city, and it is important that as many of them as possible be prepared for the work in the city's industries. Accordingly, if the manufacture of furniture is the leading industry in a community, the vocational school in that community should emphasize the woodworking trades —cabinetmaking, finishing, matching. Instruction in upholstery and design should also be given special attention. The school which stands in view of textile mills in a New England valley must specialize in machine operation, machine adjusting, dyeing, and plant maintenance. The machinery-building town of Ohio or Pennsylvania expects of its vocational school that the principal trades taught shall be those of the machinist, the foundry man, the patternmaker, and the mechanical draftsman.

This does not mean that the schools should teach only the leading vocational subjects in a community; it means merely that these leading subjects should be given the most prominence and that they be kept constantly in the minds of the students. The vocational school of a city should be a gigantic gateway through which the majority of the young people of the city can find their way most easily into the principal industries.

Again, employers are of the opinion that the vocational schools should constantly study employment conditions in the various trades, and boys should not be encouraged to enter any trade beyond the capacity of that trade to absorb them. For instance, there are few cities in which there are sufficient opportunities in drafting work for all the young men who aspire to do this kind of work. The argument will be made that each boy should be permitted to follow his own inclinations and enthusiasms, and that no boy should be thwarted in his ambitions. This principle is undoubtedly correct. The boy whose father is a mechanic, who has heard mechanical talk in his home and has seen and read mechanical books from his earliest years, who loves tools, has undoubted mechanical ability which he has demonstrated in summer work, and who

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has determined to become a mechanic himself, should certainly be encouraged in his plans regardless of conditions in the trade. Such a type will find work, and suitable work, in any case.

However, such boys are the exception rather than the rule. The great majority are very much at sea in the matter of a trade or occupation. They have done little thinking about the problem and they know almost nothing about it. Their most definite experience in this direction has been a futile enthusiasm for aviation. They welcome advice and direction and are as willing to go into one trade as another; they will make equally good grocers or tinsmiths or painters or bookkeepers. This vast majority may be influenced to go into one or the other kind of work, depending upon opportunities, and a proper proportion of young men in the occupations may thus be maintained. Public employment offices, various employers' and trade organizations, as well as government and state officials, will assist the schools in maintaining this proportion.

Overselling a Trade

A striking illustration of this problem is "overselling" a certain trade, which frequently happens, particularly when the teacher is exceptionally capable. In a vocational school of a city of about 60,000 population, the teacher in the printing department had outstanding ability. He understood his subject thoroughly and taught it effectively. He had enthusiasm to spare and was gifted with a dynamic, enthusiastic personality. Although strict with his students, he was very popular, as might be expected, and there was a great demand for admission into his classes. The authorities of the school were pleased with his work and gave him an assistant and increased equipment. His classes constantly grew in numbers and evening courses were instituted.

The result might have been expected. Young men in great numbers acquired a liking for the printing trade but were unable to find employment. A survey was made of the extent of the printing business in the city and it was found that there were very few openings for young men per year and that it was impossible to accommodate more than one third of the enthusiastic members of the class.

Probably the most familiar instance of such "overselling" is the tendency of many schools to give undue emphasis to the woodworking occupations—cabinetmaking, wood turning, and patternmaking. Apprentice directors in machinery-building plants and superintendents of pattern shops who have room for one or two pattern apprentices in a year must frequently send away more than that many apprentices every week. There is positive tragedy in the violent disappointment of hundreds and thousands of young men who cannot do the work for which they have acquired a liking.

It ought to be needless—although experience proves it is not—to point out that no official or teacher of any vocational school should ever disparage a trade or occupation.

"You don't want to be a blacksmith," a vocational-school counselor said to an excellent student some years ago. "It is hard work and I certainly would not advise you to go into it." The counselor thought the work was beneath the student and this advice was but the beginning of a definite campaign to save the boy from himself, as the counselor thought. However, the boy had an idea and a plan and the counselor fortunately did not change his mind. To him blacksmithing was merely the first step in an important group of industrial processes which he had determined to learn. He wanted to learn smithing as a foundation. Thereupon he planned to acquire skill in modern special forging, drop forging, heat treating, metallurgy and metallography. For a number of years he has been foreman in a prominent drop-forge plant and he has just been notified that he is soon to be made assistant superintendent. All work is honorable to the man who does it in the right spirit and to the best of his ability, and surely the vocational schools are the agency which, more than all others, should teach this principle rather than reject it.

Probably the greatest service which the vocational schools can render from the industrial standpoint is to impart to the students a sense of the dignity of work, especially of trade work. As a class, American young people tend to avoid all occupations which involve any manual work. "Why should I waste my time learning a trade?" a smart young American asked me a few days ago. "It is hard work and gets me nowhere. Long years at hard labor is not the American idea. I am going to learn to be clever and make my pile that way. I am going to be a salesman and when I have rolled up some big commissions I shall play the market like other people are doing and settle down on easy street for the rest of my life." And what this young man said, thousands of others are thinking. It is only natural that our young people should have this attitude when magazines, motion pictures, books, and other agencies paint this young man's ideal as the typical American. The vocational schools must counteract the tendency. They must explain and prove that for every man who becomes wealthy by a clever stroke or a turn of luck, there are countless thousands who achieve comfort, respectability, and happiness by consistent, although not spectacular work. They must explain and prove that the ability and success of the great leaders in the industrial world have been built upon the foundation of thorough knowledge of industrial work and many years of painstaking effort.

Romance in Industry

Moreover, the vocational schools may explain to their students that everyday work has not merely dignity, but fascination as well. There is romance in the mysteries of electricity. Lurid furnaces in great steel shops provide a stirring thrill which cannot be had elsewhere. There is much of the artist's joy in decorating a ceiling and four bare walls to create a beautiful room. The boy who has had a trade correctly and effectively presented to him in a vocational school, can be made to look upon it not merely as a means of livelihood, but as something attractive in itself, something that will make his whole life pleasant.

Young men have always been impressed with the need of getting experience after their education is completed. "Now go out and get your experience," prominent citizens have always told young graduates as they handed them their diplomas during commencement

ceremonies. In the old days, getting experience meant floundering about aimlessly among many skilled and unskilled occupations until a suitable line of work was accidentally stumbled upon or until it was too late to continue the process. Thus, the young graduate probably found work in the largest factory of the town, joined a section gang a little later, and then went to try his fortune in a big city, where he was employed by an express company and a department store, and then returned to his native town when he could find no further employment. There he delivered for a meat market or joined a contractor's crew. In his early twenties he married and settled down to the work he happened to be doing at the time, which may have been in the shipping department of the local creamery or the boiler room of a power plant or anywhere else.

Fortunately, times have changed, and while it is still necessary for boys to get experience, the modern idea is to discover as soon as possible the vocation for which the boy is best fitted and to give him all his experience in the chosen line of work. The young man who ultimately becomes a tailor will profit little by two years of railroading. An important function of the vocational schools is to discover by actual trial the work which the boy can do best so that he may not dissipate his best years in valueless efforts. Accordingly, if a boy is recommended to an employer by a vocational school as qualified to become a draftsman, the employer may reasonably expect that he has been tried at the work for some time, and has shown ability and temperament for the work. However, the employer cannot expect the boy to know very much about drafting.

Value of Definite Planning

Too many young men apply for work with no plan for lifework in mind. Earnings alone determine where they will work and they will change positions several times per month for the sake of a cent or two more per hour. One young man, who had been employed as a finisher in an automobile plant, gave up this job to work in a factory manufacturing steel tanks. I met him and asked him if he liked the new position better. "It pays more money and that is all I care," he replied.

"Why in the world don't you select some kind of work in which you are interested and make it your business for life?" I asked him.

"That's the bunk. I am only young once and I am going to have a good time. To have a good time I must have money, and I know that I can't make money while I am learning some trade or business."

The vocational schools can accomplish wonders by making young men take their lifework seriously. This can be done most easily by assisting the young men in the discovery of an occupation about which they can become enthusiastic, and the boy will usually become enthusiastic about work which he does well. It will be contested that the majority of young men will not get into professions or trades but will eventually be employed as semiskilled operators or even as laborers. But even for them there is a choice. A laborer may be happy in the automobile plant and utterly dissatisfied in a paper mill or a shoe factory. The problem of finding suitable work cannot be evaded.

There has been a distinct revival of apprentice training in recent years, and many vocational-school students are sent to employers to become apprentices in their plants. The employers expect these boys to be fully instructed regarding the meaning of apprenticeship. The educational director of a prominent public-utility corporation touched upon this in the course of an address before a group of vocational educators. "When you send me one of your students to become a machinist apprentice," he said, "I naturally expect that he knows what it is all about. I expect that he has been told that he will receive shop instruction on lathe, milling machine, drill press, and other essential machines, and that in turn he is to remain in our employ until he has completed his course. I expect him to understand that school attendance is necessary during his apprenticeship; I expect him to appreciate that reasonable production is required of him, although training is the most important feature of his apprenticeship; I expect him to be willing to sign a four-year indenture; I take it for granted that he remains determined to become an apprentice after being told all this; briefly, I expect him to be well grounded in the practical fundamentals of apprenticeship."

Every trade has a theoretical side and a practical side. In recent years, more emphasis has been placed upon the theoretical phase than formerly. For instance, the modern molder apprentice is not merely exercised in "pounding sand," but is taught something of melting and metallurgy, alloys and their properties, sand control, history of the industry, and even cost keeping, safety, and sanitation. Employers look to the vocational schools to give to apprentices this related theoretical instruction because it cannot be imparted in the shop.

Shopwork must go on, and foremen and shop instructors must keep it going. They teach the boys how to do the work, but their teaching is necessarily confined to giving instruction on the work the apprentice happens to have in hand. The molder apprentice is shown how to gate his mold and where to place chills and risers and the reasons why, but there is no time for a long explanation, and there are, moreover, few foremen who are able to go into the theory of all this. Their explanations will not be effective unless the apprentice has adequate theoretical instruction in the principles of molding. In addition, mathematics, sciences, and other essential subjects are not even touched upon in the shop.

Cooperation Between School and Shop

Employers and school authorities need to cooperate more closely in the instruction of apprentices. They have never divided the work. The shopman teaches the manual side of a trade, and when he is hard pressed to explain a difficult matter he is apt to tell the boy that the troublesome problem will be covered in school instruction. The teacher in the school lays down an apprentice course which may be determined as much by what he can teach and what he likes to teach as by the practical requirements of the apprentice course. Neither the shopman nor the schoolman knows what the other is teaching; no exact dividing line between theory and practice has ever been drawn nor have shopmen and schoolmen ever met in an attempt to draw such a line. In the meantime, the ap-

prentices suffer. A machinist apprentice once complained that he could get no instruction in the correct angles of cutting tools. His foreman had told him that the school teacher would take care of it and the school teacher told him that this was properly a part of instruction in machine operation and that it was the job of the foreman at the plant. Unfortunately, only too many apprentices have found themselves in a similar position.

Vocational schools will do well to teach apprentices to care for the property of their employer and of fellow workers. A great fault of boys in general is their destructive tendency, their inclination to ruin tools and equipment of all kinds. Oil is wasted, windows are broken, and valuable material is thrown away. This is largely thoughtlessness. Apprentices do not appreciate the value of property of all kinds. The employers must teach them, but the vocational-school teacher can be of assistance and such instruction can be given much more gracefully by him. For instance, a machine-shop instructor would make a deep impression upon his class by explaining to them the approximate cost of all the parts of a boring mill or other machine and the great cost of making repairs to these parts.

An outstanding service which the vocational schools can render to the industries, is to build up among apprentices a deep respect for existing institutions. Undoubtedly, the present social and industrial order leaves much to be desired. However, conditions must be improved by striving for further development, by upbuilding, by constructive action, and not by frantic destruction. Apprentices should learn in the schools that anarchism, communism, and similar movements have nowhere brought about a state of society superior to our own. Apprentices should learn that these movements tend to disrupt and confuse and that they are dangerous in general and to them personally. If such instruction can be given to 85 per cent of American young men who never reach high school or college, a sturdy citizenship will result in spite of dangerous doctrines which are taught in certain higher institutions of learning.

If vocational teachers are to carry out the comprehensive program which has been suggested, it will be necessary for them to maintain a close contact with industry. A few years ago, the instructor in patternmaking of a prominent vocational school came to the superintendent of a pattern shop after the beginning of a summer vacation and asked to be given a job. The superintendent, in some surprise, asked him why he wished to work in the shop. The instructor replied that he had been teaching for some years and that his patternmaking experience in that time had been confined to the school shop. He said that he felt himself growing narrow and that he was losing appreciation of the requirements of industry. He hoped that several months of work in an industrial shop would be very refreshing. Needless to say, the superintendent gladly gave him work on that basis. His identity remained confidential between them, and he worked throughout the summer as a regular patternmaker under exactly the same conditions as the other mechanics in the shop.

A foundry instructor was entitled to a vacation of two weeks after teaching a summer course in a vocational school. He might have spent those two weeks at some pleasant camp or resort. Ordinarily, an annual period of rest and recreation is a practical necessity. However, this instructor arranged to spend the two weeks without pay in a steel foundry as melter's helper on an electric furnace. His work was no pretense; until he left, his fellow workers were unaware that he was not a regular employee. Obviously, both of these teachers increased their effectiveness beyond all measure.

Now that an outline of some of the requirements of industry has been made for teachers of vocational schools, it would be extremely interesting to know what suggestions the vocational schools have to offer to employers.

Counseling the Non-University High-School Pupil[1]

Edwin A. Lee

IT is an interesting and exceedingly hopeful indication of clear thinking which those who are responsible for this program have shown in dividing the topic, "Counseling in the High School," into two parts. I am particularly pleased to discuss the problem of counseling the noncollegiate high-school pupil. We have only to look backward a few years to find secondary education entirely under the spell of the college-preparatory program. A discussion of university and nonuniversity high-school students as two distinct groups, to be handled differently, counseled toward different objectives, would have constituted even ten years ago so "different" an approach to a fundamental problem of secondary education as to have been unthinkable to any but the most advanced educational leaders.

At least two tenets of educational misbelief, neither of which is conspicuously absent from current thinking relative to the problem, were responsible for such an attitude of mind. The first one may be stated thus: "A high-school pupil should take a college-preparatory course even though he has no intention of entering the university, lest he find himself handicapped by lack of preparation should he later decide to enter a higher institution." Those who have accepted this statement as sound have found themselves in a dilemma, the ramifications of which have extended into the realm

[1]An address delivered before the counseling and guidance section of the Eighth Annual Conference on Educational Research Meeting of the California Educational Research Association (Northern Section) at Stanford University, April 12, 1929.

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of university-secondary school relations on the one hand, and the high-school principal-parent-pupil relations on the other. For the university, and by this I mean the university as an institution not the university on whose faculty I serve, has rather definite ideas as to what constitutes adequate preparatory training, and the trend would seem to be toward narrowing rather than extending the range of that preparation.

It is inevitable under such conditions that the most important curriculum in any high school, the one which the principal will aim to do best and for which the major part of his budget will be allocated, will be the college-preparatory curriculum. It follows that in the minds of students and parents alike, this curriculum assumes transcendent importance. When there is added the social as well as the intellectual suspicion which attaches to those who pursue any but the accepted program, the problem of counseling a high-school pupil in the first place to join the nonuniversity group is one not to be lightly attacked.

What Constitutes College Preparation

It is pertinent, therefore, in this conference on research, to ask the question: "On what defensible assumption rests the educational tenet which has been read?" Do we know, with any degree of scientific exactitude, what constitutes an adequate preparation for the university? Can it be demonstrated that an individual possessed of intellectual potentiality who has perforce failed to take the prescribed college-preparatory curriculum, is by virtue of such misadventure really handicapped? If, because of a mistake as to objective, an individual must take two years longer to prepare for college than he would had he proceeded regularly, does it necessarily or reasonably follow that he has been handicapped, or that he has really lost time? Is it unreasonable to suspect that the two years of maturity gained by the longer period of preparation may be of inestimable advantage to such an individual's university career?

Such questions as these, and there are many more which might be asked, have thus far been settled by subjective rather than objective methods. Until careful research has given us intelligible answers, we wander in a shadow which sometimes approaches complete darkness.

The second tenet, to which university and secondary-school workers, and indeed, the world at large, have clung, can be expressed in these words: "The college-preparatory curriculum is the best training which can be devised for boys and girls between the ages of 14 and 18. If one goes to college, he has been adequately prepared. If he does not, he has, nevertheless, received the basic cultural inheritance due him, and the time spent could not have been used to better advantage no matter what his future may hold." This is, of course, a comforting belief to the one who holds it, and it *may* be true—at least, it has not been conclusively proved otherwise. Certainly it is undebatable that one who counsels a student to build his high-school career along other lines, flies in the face of the tradition represented by stipulated numbers of units in foreign language, mathematics, science, and the like. One who doubts, however, may ask in the scientific spirit to what degree such a program contributes to an abundant life. One may question, and not without hope of a dependable answer, whether or not youth is capable of achieving a culture in terms of a life which it does not, and probably will not, live—whether or not culture is not, after all, a possession possible only to maturity. Or one may raise the question as to which will contribute the more to complete living, the ability to diagnose a stalled gasoline motor, or the mental agility to prove that two angles of an isosceles triangle are equal, when we know they are equal.

We could extend the list until all would cry for relief. My purpose has been served if it has become evident that the problem of counseling the nonuniversity high-school student is not as simple as the title would seem to indicate. The problem is exceedingly complex, and it will become less so only as research workers devote themselves to the pursuit of such problems as I have most crudely and inadequately presented.

Assuming, however, that the problems are not impossible of solution, let me speak now more directly to the assigned topic. What is a nonuniversity high-school student? Dr. Wilson, the eminent Harvard statistician who has been a visitor on our campus this semester, is very meticulous in his establishing of categories. Talls and shorts he would designate as talls and not-talls; wets and drys, as wets and not-wets, etc. In this way we can say that nonuniversity high-school students are all those who will never go to the university, and we can tabulate them finally only from the bureau of vital statistics. A counselor, however, is concerned not with what has been done so much as with what is now doing, and what will possibly or probably grow out of now. Nonuniversity high-school students will then include several types.

Nonuniversity High School Students

There will be the group who enter the high school with no intention of going to the university. Such a group will have several subgroups within it: a group which will stay only until the compulsory age limit has been reached; a group contemplating only two years of high school; another group which expects to stay the full four years and then go to work; a group that wants to work and go to school at the same time; a group with definite vocational objectives; a group with no objectives, harmless drifters, but potential criminals; high I. Q.'s and not-high I. Q.'s; and others which your experience will cause you to add. It is the first duty of the counselor to be aware of these groupings and as quickly as possible to place each of the nonuniversity students in his proper group. Of course, nothing new is being said, for this is simply a recognition of individual differences. But it is so easy to accept the doctrine and violate its precepts in practice that I venture to emphasize the necessity for knowing all the facts about students which it is possible to secure. The problem of counseling a student concerning his semester's program is entirely different, depending upon whether that student plans to finish high school three years from now, or discontinue formal education at the end of the semester for which he is being counseled. Any scheme which neglects this simple but fundamental principle of procedure in counseling cannot but fall short of its highest effectiveness.

If the type of procedure just suggested were universal in practice, there would be no need to mention a second type of student to which the counselor must give attention. Unfortunately we are far from satisfactory conditions, and a group which may be called the emergency group exists in nearly every school. In this emergency group are such cases as the boy who suddenly announces that "next week he will be 16 years of age," or "come 16," as they say, and that he intends to quit school and go to work; or the girl in the third year of high school who must leave in order to eke out the family income so as to tide over a period of unemployment on the part of the father; or the disciplinary case of the boy expelled because of major infractions of regulations or morals. You know the catalog as well as I, and you know that the need for wise counseling is never so pressing as it is for these emergency cases. Yet, in how few schools is there anything more than casual and superficial guidance? A well-conceived counseling program for the nonuniversity student will be geared to accommodate itself not alone to the individual differences of its students, but to their eccentricities, whether those eccentricities be due to temperament or to external conditions over which the students have no control.

Closely related to the group just discussed, and, indeed, an emergency group, is the host of boys and girls who have finished the college-preparatory course in high school, but have found their educational career cut short, for one reason or another, with high-school graduation. In a sense, this group constitutes one of the most difficult problems faced by a counselor. Prepared for college, which generally means prepared for little if anything else, those in such a dilemma must be carefully and quickly accommodated to the stern demands of modern industrial and commercial life. Our public schools have probably done less in terms of guidance for this group than for any other. A satisfactory solution of the problems involved constitutes one of the most pressing problems facing counselors today.

The group enrolled in part-time schools represents a particular section of our school population for whom the problem of guidance is acute. Incidentally, this is the only group for which the State of California has been wise enough to provide guidance legally, and California is the only state, so far as I am aware, which has written into its statutes a provision for vocational guidance for any group of its high-school students. The problem is both complicated and simplified by the fact that part-time pupils are, in the main, at work. It is complicated because the work all too frequently has been a matter of chance rather than a matter of careful choice, but it is simplified because the experience of work itself is of great value in helping a boy or girl to make decisions. An occupational information class composed of youngsters who have already met the problems of wage earning, necessity for punctuality, dependability, and thoroughness, and all the other invaluable experiences of work, constitutes an altogether different educational situation from that presented by a group of high-school pupils whose work experience is limited to that which they have vicariously shared with one or both parents. The same observation holds true for all other phases of the guidance program, be they interviewing, or placement, or testing.

What has been said of part-time pupils is even more true of evening-school students, who fall under the general category of nonuniversity high-school students. Here we add the factor maturity, an element of incalculable importance, for with maturity the idea of self-guidance increasingly takes on significance. Essentially, all guidance should eventuate in self-guidance, and it is with men and women approaching adult life that we may expect to achieve this goal most satisfactorily. Yet, a study of evening schools made by one of my students recently, portrayed an appalling lack of guidance programs throughout the United States. Students everywhere enroll in prodigious numbers in the evening schools. Within a few days the inevitable mortality begins, in a few weeks the enrollment has dropped to less than half, and the class that finishes with 20 per cent of those who originally enrolled is counted highly successful. Is it unreasonable to surmise a relationship between this regrettable waste and lost motion and the absence of a carefully conceived guidance bureau in the evening-school program?

So much for the types of students. Let us turn our attention to those aspects of the problem peculiar to, or at least more pressing for, the nonuniversity high-school student. There is first of all the problem of placement. For the prospective university student the problem, as far as the high school is concerned, simply does not exist. But for the nonuniversity boy whose next experience after leaving high school will be work, the program of placement assumes major importance. To think of a guidance program for this group without a placement bureau of some sort is inconceivable, yet even a casual investigation gives evidence of only sporadic attention to this most important aspect of the counseling program.

The Follow-up

Closely related to placement, and closely coordinated with it, is that phase of the work which we know as follow-up. Our job of guidance is not complete when we have helped the boy to find his first position. In some cases it has just begun. But to obtain adequate or accurate data from high schools concerning those who have left their walls, including even those who have gone to the university, is an almost impossible task. And to obtain records of what Johnny Roe has done in the five years since he left Alta Cruz high school, particularly if he left without graduating, is practically an impossible task unless perchance Johnny has been sentenced to San Quentin. And yet, gentlemen of the Research School, here is exactly the source of the only data by which you can really evaluate the effectiveness of the high-school program for the nonuniversity student, not only the program of counseling, but the total educational investment represented by high-school training for all the Johnny Roes and Jane Does. For the sum total of these five years wisely interpreted, exhibits the first dividends on the investment.

There is the aspect of the problem which can best be described by the word "immediacy." For some of the group we are discussing, the need for early choice is imperative. When one has four years of high school at the least and in many cases two years of college

work to pursue before actual professional training begins, it doesn't make a great deal of difference what occurs in any one year of high school. But when two years of high school represent the totality of formal education a fellow is likely to receive, what is to go into those two years and what they will lead toward becomes a challenging question. The problem of the counselor is immensely intensified by the element of immediacy of choice.

Mention has already been made of the relationship between maturity and wise choice. In the regular high school the problem of the nonuniversity student is affected by the element of immaturity. It does no good to say that high-school students are too young to make a choice of vocation. The fact is indisputable that an astounding proportion of these students of necessity do make choices. The task of the counselor, using every means and device at his disposal, is to make that choice a good choice, and as largely as is possible, a self-choice rather than a counselor-choice. But the counselor will have to accept the fact and the responsibility going with it, that he will play a much larger part in determining the choice of the nonuniversity student than he will for the prospective university student. It will follow inevitably that his training and understanding will need to be broader if he is to meet adequately the demands which such a program will entail.

In the time remaining, but one other angle of the nonuniversity-student guidance program can be mentioned. To what fields of work shall the nonuniversity student be limited? Are you surprised when I say, "not any"? Yet there are no fields of lifework to which a nonuniversity student may not aspire if he truly desires to serve. We are prone to think, for example, of the professions as being limited to the university-trained man or woman, and in the main we are right in so thinking. We make a mistake, however, when we confuse a profession with a field of service. Let me illustrate by the field of dentistry. Not so long ago the *field* of dentistry and the *profession* of dentistry were synonymous terms, and both assumed a training represented by four years in a dental college. Today, however, the field of dentistry embraces a dozen or more vocations, ranging from a research worker in dentistry to the vocation of dental assistant. Between these two extremes are such vocations as the dental mechanic, the X-ray specialist, the oral hygienist, none of whom need be more than junior college graduates, if, indeed, they need that much training. The dental assistant needs no more than high-school training, and that may be a disadvantage if of the wrong sort. What we face in this regard is the need of recognizing that there are in all fields of work what we call, for want of a better term, "levels." For the top levels, the real professions, there is necessary in many fields, a university training or its equivalent. But for the middle and lower levels such extended training is neither necessary nor desirable. There is no reason why a nonuniversity student wishing to serve in the field of dentistry should not plan to become a dental mechanic or an oral hygienist, providing always that a satisfactory method of securing training be available. Here we face our most pressing research problem in the realm of vocational education and guidance. An acceptance of the theory of occupational levels and an accommodation of our vocational-guidance and vocational-education programs thereto, in the light of the results of research, will contribute immeasurably to the general problem I have been discussing.

In closing, permit me to express my satisfaction in the knowledge that increasingly the problems of personnel and guidance are finding a place in the annual conferences of the California Educational Research Association. Adequate guidance must rest always on the solid foundation of scientific investigation and evaluation. Adequate research in education must ever be alert to the danger of losing sight of the human element. Research in guidance guarantees to both that which is essential to the best service of each.

Rib and Beam Construction in Aircraft Building

P. H. Heron *

WOOD, as a material used in the construction of wings of an airplane, is most commonly used in this country, and though metal is being used more and more for the structures of wings, it is quite probable that wood will never be entirely replaced.

The advantages of wood in this work so far have been in its strength-to-weight ratio and in the ease of fabrication. It can be milled and routed by machine, and utilizes to advantage labor which is already experienced in the woodworking industry; cabinet workers, furniture workers, and other types of labor familiar with the industry.

This has been a distinct advantage to the airplane industry, as most planes are not produced in quantities large enough to justify the use of expensive machinery and jigs necessary for the production of metal beams and ribs.

Wood, along with its good characteristics, has many bad characteristics, most of which can be overcome by proper construction. It is not a homogeneous material due to its growth. Two pieces of wood are never of exactly the same properties; one may grow faster than the other or have certain defects which will not be common to both.

Unless well protected, wood will absorb moisture which will cause it to increase in weight and swell or warp. It is also subject to fire hazard and does not lend itself to rapid production.

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The four woods most used in airplane structures (exclusive of propellers) are: (1) spruce, (2) mahogany, (3) ash, and (4) balsa.

Spruce is by far the most used wood, and since it is lighter than any other suitable wood of its strength, it is used for wing, aileron, and stabilizer spars, for ribs, filler blocks, and for streamlining tubular struts. Bass is sometimes substituted for spruce in the construction of ribs and other small parts.

Mahogany is used principally in the form of plywood which has basswood or poplar in the central layers. Mahogany is strong and holds glue readily; the plywood is used in small parts, such as rib gussets and rib webs, and also as webs in built-up box beams.

Ash is heavier and stronger than spruce or mahogany; it is frequently used for parts where strength and rigidity are necessary, and very often for filler blocks as a wood which will give a good bearing to bolts. It may also be steam-bent to form wing tips, etc.

Balsa is an imported wood which is seldom used for structural parts, but is often used for fairing on structural members exposed to the air stream. It is very light and can be worked on machines the same as any other wood.

Since wood is not a homogeneous material, the strength and properties of any particular wood is by no means stable for different pieces; certain pieces of wood may be overstrength, and others may be understrength.

The only way to get a uniform strength in wood members is by a process called "laminating." This is done by gluing a number of layers together to form one piece of the required size. This combines pieces which may be overstrength, and others which may be understrength into one piece, which has as its strength the "average" of all the original pieces; this also effects uniform swelling and shrinkage in changes of moisture content and counteracts any tendency for the member to warp. While this is, no doubt, the best form of construction, it involves extra labor and use of glue and suitable presses.

Laminating is distinguished from plywood in that the grain of the layers always runs parallel, while in plywood the grain of each ply runs at an angle to the next.

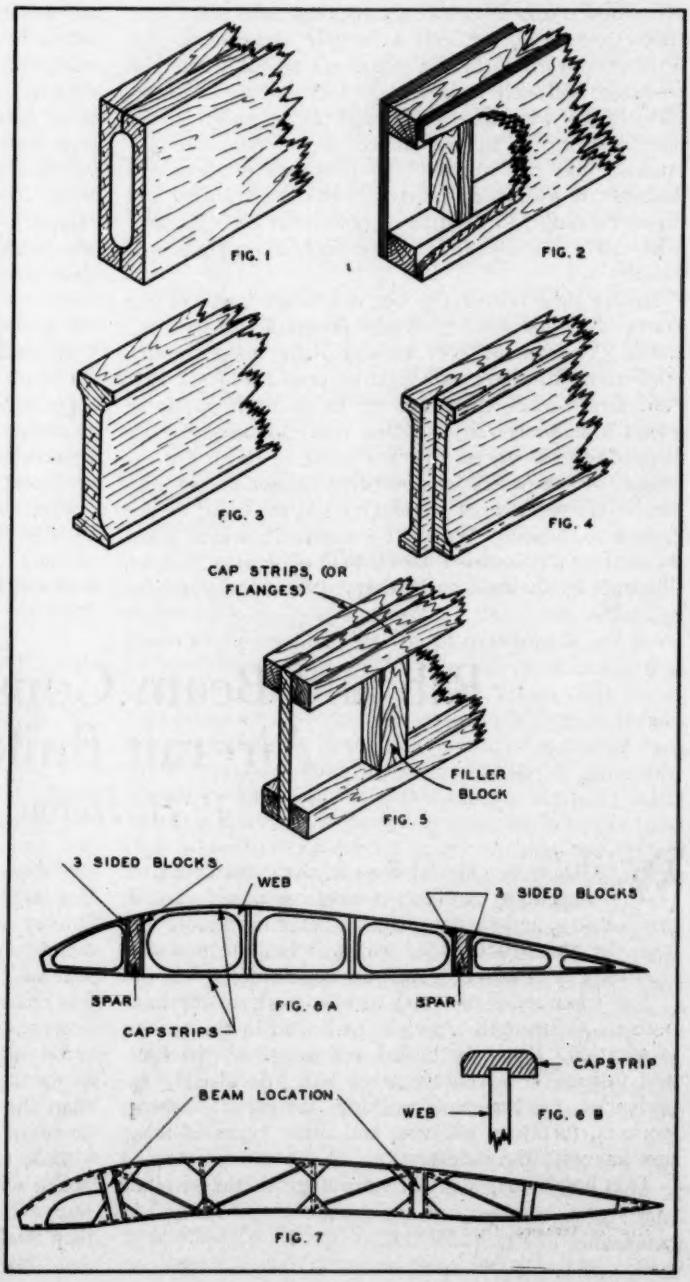
Beam Construction

At present, there are three types of beams or spars used in wooden-wing structures; they are the box beam, the I beam, and the rectangular or solid beam.

Box Beam. The principal advantage of this type of beam is that the construction concentrates the material around the outside of the beam, giving it a tubular shape, which is stiffer in torsion than any other shape. This feature is essential to wings which have no external support, as it helps to prevent wing flutter (a condition which is set up at low angles of attack and very high speeds, when the wing may receive variations in the location of the center of pressure which causes it to oscillate or vibrate; this is harmful to the comparatively delicate parts of the wing structure). The box beam is used in cantilever monoplanes or in biplanes where the overhang is great.

The beam may be made up in two ways, a routed beam or a built-up beam.

The routed beam is by far the simpler of the two, but can be used only in the smaller untapered wings. The construction of this beam is shown in Figure 1. It is made up by routing two pieces of wood—usually spruce—which are then glued together as shown. Sections of the beam are left unrouted at points where wing or drag bracings and fittings are bolted; this



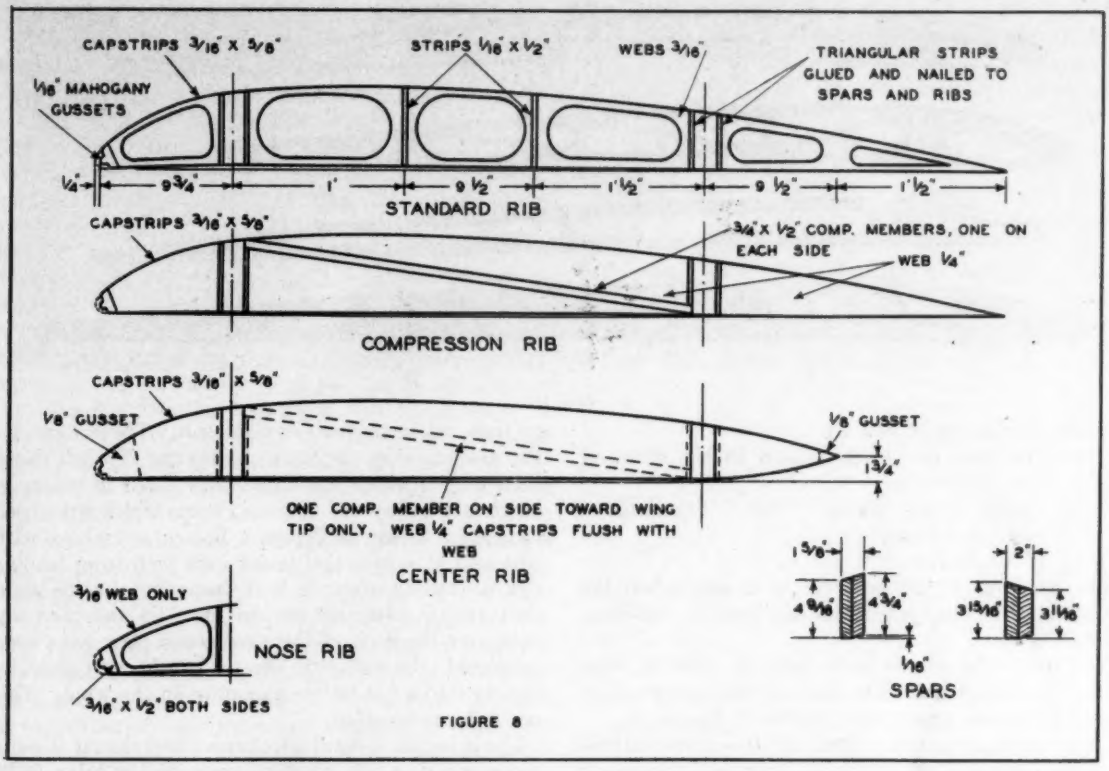


FIGURE 8

leaves a foundation for bolting, and also acts as a reenforcement against a collapse of the thin web. The routed box beam will necessarily be a small one, since it is extremely hard to get wood in pieces large enough to make a large beam.

A beam which is more readily adapted to larger structures, is that of the built-up box beam. It is made up of two flanges or cap strips and two webs; the flanges are usually of spruce, and the webs either of mahogany or spruce plywood. The beam is assembled with glue and nails, as shown in Figure 2. The plywood used differs from ordinary plywood in that it usually has two or four plies instead of three, with the grain of the plies running at right angles to each other and at 45 degrees to the edges of the strip. Blocks are put in the beam at points where fittings are bolted, and small stiffener blocks are inserted at intervals throughout the length of the beam to prevent the plywood from buckling under strain. It will be seen that this type of beam involves a great deal more labor than the routed type, and is used only in the larger wings.

The *I beam* is one which is somewhat easier to construct than the box beam, but it lacks the torsional rigidity of the box beam, and is therefore used principally in biplane or semicantilever monoplane structures, which do not have excessive overhang. The I beam is built in two forms, routed and built-up, as is shown in Figures 3, 4, and 5.

The routed beam is used in the smaller biplane wings, and may be either solid or laminated. The solid I beam is shown in Figure 3, and the method of laminating, when this is done, is shown in Figure 4. The beams are not routed throughout their length, but have solid portions at such points where fittings for wings and internal drag wires are located in order to give more bearing area to the bolts. This type of beam is made almost entirely by the use of machines, and involves very little labor; consequently, it is less expensive to manufacture than the box beams.

In the larger biplanes and semicantilever monoplanes where wings are of such size that it would be hard to get pieces of wood large enough to make routed beams, a built-up I beam is used. This is made up of a web and four cap strips or flanges, the flanges being glued in a large press to the outside edges of the web, as shown in Figure 5. Stiffener blocks are glued and nailed to the webs at intervals of from 12 to 20 inches, to prevent the web from cracking or buckling. At points where fittings are fastened, filler blocks are fastened to the beam to give a solid section for bolting. These filler blocks may be of either spruce or ash. One particular advantage of this beam is that there is very little waste of material, even though it requires more labor than the routed beam. It may also be made somewhat lighter, as the flanges may be reduced in size by tapering where the loads are light.

Rectangular or *Solid Beams.* With the increased production, several manufacturers are turning to the use of a solid rectangular beam. This beam can be made either of one piece or laminated of two pieces, which merely requires that the pieces be glued together in a press. It is readily seen that the advantage of this beam lies in that it requires no extra labor in routing or shaping. At first thought, it would seem as though this beam might be excessively heavy. It should be remembered, however, that spruce in the rectangular shape is stronger than in either the box or I section, and, consequently, does not require as large a beam as the other type.

Ribs

There are, in general, four kinds of ribs used in wing structures.

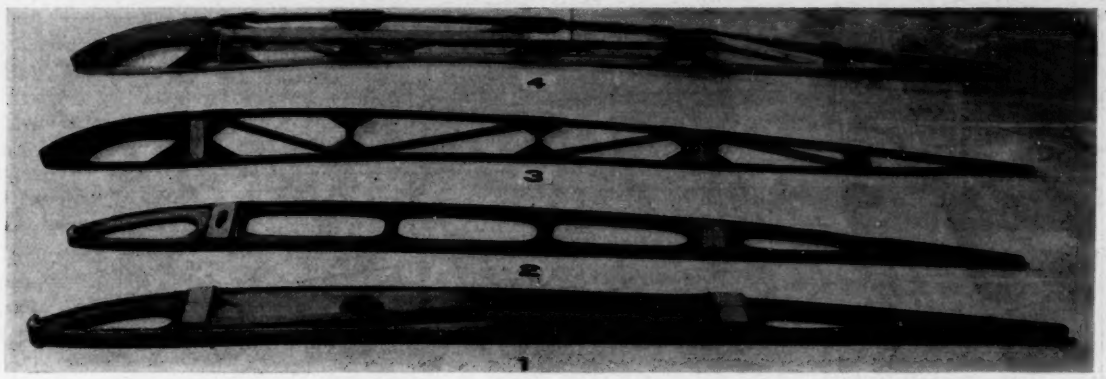


FIG. 11

These four kinds of ribs are:

1. The nose rib, often known as the riblet or false rib.
2. The form rib—"Truss," "Web," "Standard."
3. The compression rib.
4. The solid rib.

The function of the nose rib is to strengthen the airfoil section at a very important part of the wing, its leading edge.

The form ribs, as the name implies, give the wing its true form and transmits the load that occurs upon them to the wing spars. See 2 and 3 in Figure 11.

The compression rib is used for the same purpose as is the form rib, but in addition carries compression stresses due to the internal drag bracing of the wing. See 4 in Figure 11.

The solid rib serves the same purpose as the form rib and compression rib. This rib is usually stiffened on the sides with good straight-grained spruce. See 1 in Figure 11.

Of the types of ribs used in wooden wing structures, there are almost as many as there are different airplane designs. The characteristics of each, however, should be about the same.

First, the rib must be one which is simple and easy to build. In order to keep the cost of manufacture low, it should have as few parts as possible, and be made of material which is not prohibitive in cost. It should be so designed that each rib, when finished, will be exactly the same in shape as all others; that is, it should not be designed so that the strain of bending parts, such as cap strips, will tend to distort the rib, or set up strains in it which might cause it to lose its shape in flight or when it is subjected to moist air. It should also have a strength-weight ratio of at least 800 to 1000 pounds evenly distributed along its lower surface, or a ½-pound rib should carry a load of 400 to 500 pounds.

A rib commonly used in wings where the chord does not exceed 6 feet, is one known as a *web* rib. This type of rib has been constructed for a great many years, and it has proved satisfactory; however, it is gradually giving way to designs which are somewhat lighter.

The rib is constructed of three webs; ie., the nose web between the leading edge and the front beam, the center web between the beams, and the trailing web between the rear beam and the trailing edge. The webs, which are usually of spruce or basswood, are first cut out to the proper camber on a jig saw, and holes are then cut in the web to lighten it. These webs are then assembled on the beams by the use of small three-sided blocks which are nailed and glued in place, as shown in Figure 6-A; then cap strips which have been routed, as shown in Figure 6-B, are assembled with nails and glue over and under each web from leading edge to trailing edge. It is the practice of some manufacturers to assemble the ribs in a jig and then slip them over the ends of the spars when they have been completed. In this way, the rib can be varnished by dipping into a vat before assembly on the wing. This speeds up production.

The principal advantage of this rib is that it is quite strong and does not involve a great deal of labor in its construction, but it has a disadvantage in that its construction involves considerable material waste, and also that it cannot be built in large sizes, since pieces large enough to make the webs would be very expensive.

A variation of this rib is one which is assembled in the same manner, but which had its webs made of plywood instead of basswood or spruce.

A rib which is commonly used is that termed a *truss* rib. (See Fig. 7.) Its construction is such that it is adapted to ribs of large wings. The design utilizes efficiently every bit of the material used in the rib; this gives a high strength-weight ratio and involves very little waste. The truss may be of either the Pratt or Warren type, or a combination of both.

The material for this rib is invariably spruce for cap strips and bracing, and mahogany plywood for gussets at the joints. The rib is completely assembled with glue and nails in a jig and is then varnished by dipping. The rib is then slipped over the wing beams and held in place by nails and glue. A variation of this type is one constructed with cap strips, made up of a strip of plywood cut to the camber of the wing over which a routed spruce strip is glued; braces are nailed and glued between the T sections thus formed.

It is apparent that either of the trussed ribs involves more labor than the web rib, but other advantages may offset this.

A number of variations of the above ribs may be found in practice, but these two types are the principal ones used and their advantages and disadvantages may be applied to other ribs which are similar to their construction.

Figure 8 shows the drawing of commercial airplane ribs, *standard* or *web rib*, the *compression rib* and a

center rib with one compression member, and *nose rib*.

The web of the standard rib is made of 3/16-in. stock spruce, and is jig-sawed out to make it as light as possible. The nose, center-section, and rear-section webs, are three separate pieces. The grain runs in the direction of the cord. The cap strips are 3/16 by 5/8-in. strips, glued and screwed to the webs and are continuous from leading edge to trailing edge. Reenforcing gussets are used on the nose and web. Triangular strips of spruce are glued and nailed on all four corners around each spar. This is done to relieve the strain otherwise carried by the cap strip. The compression rib is constructed with a 1/4-in. web and two additional compression members. The web is not cut out as in the standard or web rib, but is left solid so that the compressional strength will be as large as possible. The center rib is shortened from the rear spar back, to yield greater visibility for the pilot. The nose rib, or false rib, is used between ribs to prevent sag in the fabric.

Besides knowing the construction of ribs, it is necessary to know how to reproduce a chosen wing section from the National Advisory Committee for Aeronautics Reports, to any size we may desire. A cross section of a wing is known as an airfoil section or simply a wing section. In the N. A. C. A. Report No. 244, there are a great many wing sections that have been tested in experimental laboratories of England, France, Germany, and America. The results obtained give a great deal of information to airplane designers and builders. By being able to understand the information published, you can, with a little study, pick out the best wing section for a particular performance.

N. A. C. A. Reports contain graphs, upon which have been drawn curves expressing the values of lift coefficient (CL), drag coefficient (CD), lift-drag ratio (LV), and center of pressure (CP), variation of various angles of incidence; i.e., an angle of attack.

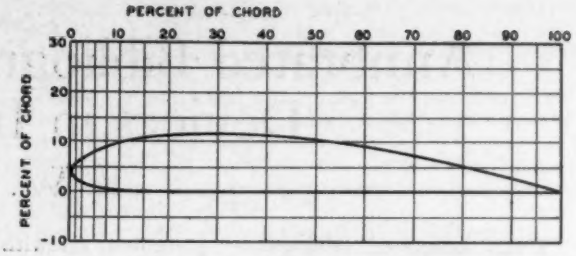
Figures 9 and 10 show graphs of the wing sections known as the Clark X and the U. S. A. 35. You will notice that the coordinate system of plotting curves is used.

The procedure of laying out a wing section is as follows:

Decide upon the cord length which your airfoil shall have, and multiply this length by the percentages given in the table (first column). This divides the cord into a number of stations. The next two columns marked "upper" and "lower," give in per cent of the cord, the height of the upper and lower surfaces at their respective stations. The stations are laid out from the leading edge from the per cent column and the points from the upper and lower surfaces given in columns marked "upper" and "lower." To obtain the wing curve, connect the points thus found.

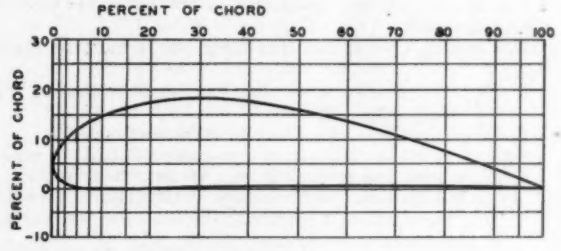
Let us plot, for example, the wing curve in Figure 9.

Draw a horizontal line equal to the cord length of the wing. Divide this cord line into 10 equal parts and show vertical stations through each division. Each part will represent 10 per cent of the cord length. You will note that the wing section always curves most at the nose or leading edge. It will be necessary to draw this part of the section to subdivide the first 10 per cent of the cord length in 1¼, 2½, 5, and 7½ per cent.



PERCENT	UPPER	LOWER
0	4.00	4.00
1¼	5.81	2.47
2½	6.66	1.48
5	7.96	1.14
7½	8.92	0.88
10	9.66	0.50
15	10.66	0.24
20	11.28	0.03
30	11.70	0.00
40	11.40	0.00
50	10.52	0.00
60	9.15	0.00
70	7.35	0.00
80	5.22	0.00
90	2.80	0.00
95	1.49	0.00
100	0.12	0.00

CLARK X
FIGURE 9



PER CENT	UPPER	LOWER
0	4.33	4.33
1¼	8.09	1.62
2½	9.58	0.95
5	11.83	0.42
7½	13.58	0.22
10	14.88	0.10
15	16.80	0.00
20	17.72	0.08
30	18.43	0.25
40	17.86	0.44
50	16.16	0.60
60	13.91	0.67
70	11.12	0.65
80	7.88	0.55
90	4.33	0.32
95	2.39	0.19
100	0.43	0.00

U.S.A.35
FIGURE 10

The next step, using the cord line as a base line, measure 1, 2, 3, etc., up to 12 per cent of the cord on the first vertical station being at 0 per cent of thickness of the airfoil.

Referring to our table at 0 per cent of cord length, the upper curves known as the "upper camber" is located at 4.00 per cent; at 1¼ per cent the upper curve point is at 5.81; at 2½ per cent the curve passes through a point 6.66 per cent of the cord length in height above the base line beginning at 0. By plotting all of these points in this manner and drawing a smooth curve through them, you will reproduce this wing section.

Annotated Bibliography of Supervisory Devices in Industrial Arts

R. W. Fowler *

THE annotated bibliography presented herewith represents a study of the literature obtainable about supervisory devices in industrial arts. The purpose of the study was to assemble material in a condensed form for teachers and supervisors.

1. BAUERSFELD, A. G. "The Plan Your Future Home Competition," INDUSTRIAL-ARTS MAGAZINE, Volume 18, January, 1929, pp. 4–7.

Development of interest was obtained through the use of a slogan and awards were given for the better work. This was carried on in the Chicago high schools during the second semester of the school year 1928–1929 and involved 19,780 pupils taking drafting in the 24 senior high schools. A project problem like this, growing out of the regular classroom work, stimulates pupils to creative efforts that are decidedly worthwhile experiences.

2. BERG, ROBERT D. "The Cooperative Method of Conducting Shop Classes," Industrial Education Magazine, Volume 29, February, 1928, pp. 279-281.

This is an interesting application of production methods to school shopwork.

In summing up the situation these points must be made clear.

1. That the teacher saves time by demonstrating to the first group only.
2. Time saved is used for lecture on related material.
3. Time saved by class allows a greater production of work.
4. Each pupil leaves class at end of term with a project finished according to the ability of the class as a whole.
5. That there will be a surplus to dispose of as the teacher or authorities may see fit.
6. That the teacher can, by using the cooperative or factory method, get the most information to the boy who can best use it.
7. That the slow-working boy will be more satisfied because he is not brought into direct competition with the fast-working boy, and the dexterous boy will have no maximum, consequently no time to waste.

The advantages of the cooperative method over the individual method of shopwork are:

1. Economy of time.
2. Fewer projects for teacher to look after.
3. Greater service to larger number of individuals.
4. Better organization of work.
5. Safety in operation of machines.
6. Opportunity for training in leadership.
7. Opportunity for team work.
8. Aid to discipline.
9. Unity of class.

3. BOLLINGER, J. W. "Some Problems of the General Metal Shop," INDUSTRIAL-ARTS MAGAZINE, Volume 16, May, 1927, pp. 161–163; concluded, June, 1927, pp. 209–211.

The article is divided into the following:

1. Advantages of the multiactivity shop.
2. The space required for a multiactivity shop.
3. Choice of activities to be included.
4. The layout of the shop; illustrated.
   a) A list of equipment is given.
5. Problems of organization.
6. The keeping of records.

This may be found to be useful in establishing a new course and it is an interesting bit of information for any industrial-arts worker.

4. BRACE, GEORGE M. "Manual Arts in the Junior High School," INDUSTRIAL-ARTS MAGAZINE, Volume 16, June, 1927, pp. 203–205.

The article contains the following:

1. The problem of what to offer.
2. Functions in the junior high school.
3. The method.
4. Vocational guidance.
5. Shopwork.
6. Mechanical drawing.
7. Helpful devices.
8. Grading accomplishments.
9. Home mechanics.
10. Equipment.
11. The teacher.

The information, relative to the above outline, should prove interesting to supervisors and instructors of industrial arts in junior high schools, because of its general value and helpfulness as an aid to instruction.

5. BURLING, B. B. "Practical Problems of the Electrical Course for the Junior High School," INDUSTRIAL-ARTS MAGAZINE, Volume 16, August, 1927, pp. 291–293.

The article is a very interesting and practical discussion; including a course of study that could be followed by many schools, to good advantage.

It contains the following:

1. A guide based on safety.
2. The nature of electrical jobs.
3. Suggestions for laying out electrical jobs.
4. A three-semester course in electricity.
5. Advanced electrical work.
6. A summary of the advantages of the recommended course.

6. CROWLEY, C. A. "A System of Printshop Instruction and Management," INDUSTRIAL-ARTS MAGAZINE, Volume 18, April, 1929, pp. 132–136.

The problem of properly caring for and maintaining equipment in a school printshop is discussed. The article is divided into the following:

1. Job ticket, with illustrated samples.
2. Elementary composition.
3. Caring for the rapid pupil.
4. Job execution chart, with illustrated samples.
5. Student job ticket.
6. Special job ticket.
7. Group job ticket, with illustrated sample.
8. Recording progress, with illustrated record card.
9. Equipment inspection record, with illustrated sample.
10. Grades reflect all elements.
11. Other applications.

The application of the system, as suggested, would increase the efficiency of teaching.

7. DELL, S. M. "Industrial-Arts Contests and Exhibits," INDUSTRIAL-ARTS MAGAZINE, Volume 17, May, 1928, pp.167–172.

This is a clear and valuable discussion of the merits of contests and exhibits in order to create: greater interest; stimulate production; raise the standard of workmanship; stimulate originality; and help to sell industrial arts to the community. Several good illustrations of school exhibits are included. This type of activity should help to unify the school and the general public.

8. FEUERSTEIN, ARTHUR. "Issuing a Department Bulletin," INDUSTRIAL-ARTS MAGAZINE, Volume 16, November, 1927, pp. 411–412.

The bulletin serves several important needs; they are listed as follows:

1. It unites the boys of the department.

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2. It stimulates a desire to do better work.
3. It is a means of acquainting the school with the work of the department.
4. It is a means of instruction.
5. It is also a means of publicity.

Other divisions of the article follow:

1. Making up the bulletin.
2. Distributing the bulletins.
3. Using the bulletins as a means of instruction.

This is interesting not only from the standpoint of its service to the needs of the school, but its proved worth in use.

9. FRYKLUND, VERNE C. "Instruction Sheets and The Principles of Teaching," The INDUSTRIAL-ARTS MAGAZINE, Volume 16, February, 1927, pp. 41–44.

This is an instructive article which shows how the instruction sheets follow the principles of teaching. It is divided into the following:

1. Reasoning and solving problems.
2. Methods.
3. Correlation.
4. Doctrine of discipline and information sheets.
5. Interest and effort.
6. The instruction sheet.
7. The instructor.

10. HENIG, MAX. S. "The Validity of Teachers' Ratings," INDUSTRIAL-ARTS MAGAZINE, Volume 16, February, 1927, pp. 51–53.

This is a good article for supervisors to read and to follow, by checking up on the same items within their own systems. The author tells about a situation which arose that led the principal to the selection of teachers' ratings as a subject for faculty meetings. The subject for the meeting was outlined as follows:

1. Relation between teachers' and pupil problem cases.
2. Theory of the normal frequency curve.
3. Trade instructors' ratings compared to normal distribution.
4. Suggestions for improving the ratings' situation.
5. Discussion.

11. HUNTER, WILLIAM L. "Objective Tests in Shop Courses," Industrial Education Magazine, Volume 29, June, 1928, pp. 433–439.

A comprehensive discussion of the use and value of objective tests in the shops.

The article is divided into the following:

1. Content of shop courses.
   a) Skills.
   b) Items of knowledge.
   c) Appreciations and attitudes.
2. Kinds of tests.
3. Values of objective tests.
   a) Increased motivation on the part of the learner.
   b) A guide for the improvement of instruction.
   c) Locate special student difficulties.
   d) Survey use.
4. Advantages of objective tests.
   a) They are more nearly fair to the pupils.
   b) They are more interesting to the pupils.
   c) Take less time.
   d) More scientifically constructed.
5. When to give tests.

12. MANSPERGER, D. E. "Testing the Industrial Arts in the Junior and Senior High Schools," INDUSTRIAL-ARTS MAGAZINE, Volume 18, February, 1929, pp. 49–51.

This is an instructive article on selecting tests and their value in teaching industrial arts. Information is given relative to when tests should be given.

13. NASH, H. B. AND VAN DUZEE, R. R. "Standard Performance Tests in Industrial-Arts Woodwork, INDUSTRIAL-ARTS MAGAZINE, Volume 17, July, 1928, pp. 229–231.

Contents of the test are: (1) the working directions, telling the pupil what operations are to be performed and the order in which these should be done; (2) a pictorial drawing showing how the block should look when completed; (3) a working drawing giving all the dimensions and other necessary information.

A good summary of the uses of the test is given. This article should prove of interest to instructors of woodwork; however, adaptations could be made in other industrial-arts work.

14. NEWKIRK, L. V. AND STODDARD, G. D. "The General Shop," Manual Arts Press (1929), chapters 2, 3, and 7.

Chapters 2 and 3 deal with teaching and management devices in the general shop. Chapter 7 deals with tests and measurements in the general shop.

15. PAUSTIAN, H. J. "Check List for Checking Teaching Technic in the Shop, INDUSTRIAL-ARTS MAGAZINE, Volume 18, February, 1929, p. 63.

A worth-while check list is divided into the following parts:

1. Starting the class.
2. Demonstrations.
3. Recitation.
4. The teacher's personality.
5. Shop technic.

16. QUACKENBUSH, G. N. "A Device to Assist in the Grading of Mechanical Drawings," INDUSTRIAL-ARTS MAGAZINE, Volume 17, December, 1928, pp. 452–453.

A mechanical device is described for the comparison of drawings, with drawings that are correct in every detail, in order to score them more efficiently and rapidly. The method of using the device is explained and an illustration of it is shown.

17. RODGERS, ROBERT H. "Job Sheets in Vocational Teaching," INDUSTRIAL-ARTS MAGAZINE, Volume 16, April, 1927, pp. 119-121.

A very good discussion of the use of the job sheets in vocational teaching. It should be studied by all who are interested in vocational teaching.

The following subdivisions are worthy of consideration:

1. The development of the job-sheet idea.
2. The instructional problem in vocational classrooms.
3. Some basic educational factors involved in the problem.
   a) Significance of individual differences.
   b) Interest as the basis of educational progress.
   c) Self-activity and the process of acquisition.
   d) The curriculum.
   e) The teacher.
4. Job sheets or units of instruction as a method.
   a) Elements entering into the make-up of individual units.
   b) Using the job or the unit sheets.
5. Some results from the use of units of instruction.
   c) The instructional material for vocational classes is now better organized in all of its details than ever before.
   b) Teachers are now recognizing that students are different and are offering instruction in terms of their individual differences.
   c) Recognition of the individual as the unit of instruction provides the opportunity for the teacher to assign the type and kind of problem that will interest and thereby insure the self-activity essential to educational progress.
   d) The job sheet or the unit of instruction, educationally conceived, has been a factor in enriching the course of study in the vocational subjects.

18. RODGERS, ROBERT H. "The Professional Education of the Teacher in Service," INDUSTRIAL-ARTS MAGAZINE, Volume 17, May, 1928, pp. 155–157.

A valuable article; it should be of interest to supervisors and administrators from the standpoint of improving teaching.

This article includes: the teaching problem in a part-time vocational school; teachers and their preparation; and a plan for the professional education of teachers in service. Some conclusions may be summarized as follows:

1. Teachers do not come "ready-made" to a particular institution from any source.
2. Teacher-training institutions cannot be expected to prepare teachers for the specific duties or responsibilities of a given school or system.
3. The nature of the training-in-service program should be determined only after a careful analysis of the needs of individual teachers.
4. The training should be a definite part of the activities of the school system.
5. Teacher training in service is not a burden upon the

teacher if it has values which they appreciate. Under these conditions it serves to stimulate and build efficiency and professional morale.

19. SELVIDGE, R. W. "The Teacher's Plan, INDUSTRIAL-ARTS MAGAZINE, Volume 16, March, 1927, pp. 78–82.

This very instructive article covers the teacher's plan in detail and tells how plans are best made. It should be of interest to both supervisors and teachers as a method of improving teaching. It is divided into the following:

1. A suggestive list of accomplishments.
2. Listing items on basis of frequency and importance in use.
3. The lists.
4. The purpose of the list.
5. The solution of the problem.
6. Checking the items in the several jobs.
7. Instruction sheets effective for instruction purposes.
8. Job plans.
9. The working out of projects.

20. SNADDON, G. H. "How to Use the Question in Teaching the Industrial Arts," INDUSTRIAL-ARTS MAGAZINE, Volume 16, December, 1927, pp. 451–453.

A worth-while study of the use and efficiency of the question-and-answer form of recitation in industrial arts is given, with a summary of findings and a good discussion.

21. STONE, W. A. AND KNOBLAUCH, G. "The Equipment and Organization of a General Metal Shop," INDUSTRIAL-ARTS MAGAZINE, Volume 18, May, 1929, pp. 169–172.

A general metal course should include samplings of the most common metal-working occupations.

One of the first problems is that of equipping and organizing a shop to carry on the work.

The guides to the equipping of a general shop are as follows:

1. Determine the units that are to be included in the general-shop course.
2. Determine what type of class organization is to be followed.
3. Make plans to use the space and equipment already available.
4. Add new equipment to accommodate classes of the size that one is apt to be required to teach.

A plan is shown of the layout of the room and equipment, before and after it was converted into a general metal shop. Supervisors and teachers should be interested in this article, because of its practicability and usefulness in the installation of a new course.

22. SWOPE, AMMON AND WOOD, H. E. "Individual Instruction Sheets for the Prevocational General Shop," 1927.

Job sheets, information sheets, and operation sheets are given in the following: concrete; electricity; forging; molding; patternmaking; sheet metal; and wood finishing. It is a very interesting and valuable piece of work, because of its practicability. The introduction is very interesting, to shop instructors, from a historical viewpoint.

23. SWOPE, AMMON. "Why Use Special Methods in Trade Teaching," Industrial Education Magazine, Volume 29, February, 1928, pp. 271–273.

The discussion is a clear and worth-while consideration of the problem as to why we must give more attention to special methods in trade teaching.

24. SWOPE, AMMON. "How to Construct Objective Tests in Industrial Subjects," Industrial Education Magazine, Volume 30, July, 1928, pp. 7–9.

The article is of value because it may be used as a tool in the construction of objective tests by those who are inexperienced in constructing such tests.

The following are some of the means for increasing the validity of objective tests:

1. Analyze the trade or subject for the things a competent worker must know and be able to do.
2. Determine the items to be used in testing, writing out a statement for each one.
3. Decide on the form of the question, such as multiple choice, best answer, and so forth.
4. The items making up the test should be arranged in some predetermined order.
5. The test should be made so that the scoring may be easily, quickly, and accurately done.
6. The directions to the student for marking the test should be clear.
7. Two equivalent forms of the test should be prepared.
8. The items in a test should be stated in a clear-cut manner.

25. SWOPE, AMMON. "How to Construct and Use a Shop Rating Scale, INDUSTRIAL-ARTS MAGAZINE, Volume 17, January, 1928, pp. 9–10.

This article tells how to measure by a rating scale and when it can be used. It also gives the method of construction of the scale. This is a short, clear article of value, because it is practical to instructors and supervisors of shopwork.

26. TAYLOR, A. C. "Motion Pictures as a Teaching Aid in a Trade School." INDUSTRIAL-ARTS MAGAZINE, Volume 18, February, 1929, pp. 57–58.

A very valuable teaching device is presented. A list of outstanding films especially desirable for use in a trade school is given. A list of questions is given to illustrate how to prepare the students to see a picture.

27. TOCK, NORMAN C. "A Grading Method for Printing Classes, INDUSTRIAL-ARTS MAGAZINE, Volume 16, January, 1927, pp. 5–8.

An interesting method of grading; of special value to supervisors and teachers of printing; however, this method might be applicable to other industrial-arts work as well.

Putting the grading system on a point basis takes care of variation and irregularity. Each class has a secretary and two foremen, appointed by the instructor, to aid in the work.

The grading scale used is given in the article.

28. WAHLSTROM, L. W. "Advertising the School Plant," Industrial Education Magazine, Volume 29, June, 1928, pp. 448–449.

Administrators and supervisors will find this article helpful in unifying schoolwork with the public.

Advertising pays and is a legitimate and modern method of acquainting the public with a product which has been prepared for its use.

Some of the means which may be used are:

1. Exhibits.
2. Billboards.
3. Leaflets and folders.
4. Publicity squads.
   a) Printed matter may be distributed; lantern slides and movies of the various shops and activities of the school may be displayed.
5. The daily press.

29. WHITCOMB, F. C. "Practice Teaching in the Manual Arts and Industrial Education," The Eighteenth Yearbook of the National Society for the Study of Education, Volume 18, 1919, pp. 345–348.

Clear account is given of what was done in 1919, and the views as to what should be done, relative to practice teaching. It is interesting to compare this article with our present ideas and practices.

30. WICHMAN, G. H. "Safety Education in the Shop," INDUSTRIAL-ARTS MAGAZINE, Volume 18, February, 1929, pp. 58–60.

In this article a list is given of some of the most common shop hazards, with suggestions for their prevention. An article that should be read by all shop teachers and supervisors.

31. WILLIS, URBAN G. "The Supervision of Shop Instruction," Industrial Education Magazine, Volume 29, August, 1927, pp. 45–48.

This is a good explanation of shop supervision. The following are listed as methods of supervision:

1. Visitation.
2. Testing.
3. Holding conferences and meetings.
4. Inspection of completed work.
5. Demonstration teaching.
6. A consideration of the teacher's grades and failures.
7. Urging teachers to read educational books and magazines, to study, to attend educational meetings, to write articles, and to speak whenever the opportunity offers.
8. Bulletins to the teachers.
9. Distribution of self-rating cards to teachers.

The information desired as a basis for supervision is divided into the following:

1. Spirit and attitude of the pupils.
2. Occupations of pupils.
3. Occupation of teacher.
4. Physical conditions.
5. Teacher's administrative ability.
6. Methods and devices.
7. Spirit and attitudes of teacher.

32. WOOD, HARRY E. "Training General Shop Teachers," INDUSTRIAL-ARTS MAGAZINE, Volume 16, April, 1927, pp. 125–126.

A good description is presented of teacher training in the writing of lesson sheets. The following are illustrated:
1. A job sheet.
2. An information sheet.
3. An operation sheet.

33. WRIGHT AND ALLAN. Administration of Vocational Education, John Wiley and Sons, Inc., 1926, chap. 9, pp. 186–208.

This is a rating scheme for use in connection with a united trade program, including a graphical representation. It improves the efficiency of teaching.

School Clubs

Joseph B. Kelly *

"WHEN Work Becomes Play," is the title of an interesting editorial in the December, 1927, issue of the INDUSTRIAL-ARTS MAGAZINE, which ought to inspire any teacher, especially the teacher of industrial arts. By following the suggestions contained in this editorial, the teacher will prepare his students to turn the work of life into pleasure and play after they have left the portals of the school.

Play in work, or interest in work, has been the motto at the Johnson School in Scranton, for the past few years, and it has been injected through the medium of the woodworking club. This club is composed of all the students in the woodworking and architectural-drawing classes. The instructor acts only as an adviser in the conduct of the affairs of the club. That the boys of the school enjoy the club is shown by the wholesome interest it has promoted, and by the good attendance at the club meeting which is held weekly in the assembly room. Speakers are developed, knowledge is gained by the speeches, and parliamentary law is acquired at these meetings.

The regular business meetings are conducted first. The different officers and committees give their reports, after which two members each give a short talk on some subject pertaining to the woodworking course in general. These topics are checked over by the instructor before they are given before the meeting, primarily to see that the speaker does not generalize too much. The subject matter of the topics, however, is entirely the work of the speaker.

After the talks, a round-table discussion is held. Often these discussions prove to be more interesting and educational than the talks given by the speakers.

Another interesting factor is the report given by a member of the various classes relative to the progress being made on the various jobs under way about the school. The students who are to make this report for the various classes are appointed each week by the president of the club, so that almost every member has an opportunity to act in this capacity during the year. The information obtained in this way keeps all of the members informed as to the work done by the entire department. This is an important factor in helping to stimulate interest.

At present, plans are under way for the adoption of a specially designed club pin. This insignia will, no doubt, help to arouse still more interest in the club.

The property committee is also very interesting. The duties of its members are to trace lost tools, account for and check damage done to tools, and work up an honor system among the boys in regard to school property.

Perhaps one of the most important functions of the club is to promote good reading through the club library, which consists of a large number of excellent books and magazines on trade subjects. One of the members who is elected librarian, has complete charge of distributing and collecting the books and magazines. He also checks the monthly book report which each member submits on the books which he has read. These reports are also checked by the teacher of English for grammatical errors and to see that the boy is absorbing all he should from the reading. Each boy is required to read one book each month, and one or more of the monthly trade magazines which come to the school. This gives the boy information on what is going on in the industrial world and brings to his attention any item of importance concerning the trade in general.

"Work becomes play when it is voluntary; work is voluntary when it satisfies the ambition to accomplish and pride in accomplishment," states the editorial mentioned in the opening paragraph of this article, and the club has accomplished just this with the boys at the Johnson School. The members of this club will eventually go out into the trades, or in time they will teach other boys how to turn work into play.

SIDE VIEW OF DUTCH DESK, SHOWING DETAIL OF INLAY WORK
Brooklyn Museum Collection

*Scranton, Pennsylvania

INDUSTRIAL-ARTS MAGAZINE

J. J. METZ, Editor

AN IDEAL TEACHER

What characteristics must the ideal teacher possess? How is he to be recognized? Are there any such? Of course, ideal teachers have been described again and again, but usually the description has been in the most general terms.

Probably the first requisite of such a teacher is that he lives a clean, blameless life himself. It is only by so doing that the best influence can be exerted by him on the student.

Then too, the teacher must prove to the student, by his own actions in the classroom, that honesty and justice is essential in a person's character.

By personal diligence in preparing the instructional material for the classroom, the teacher must demonstrate to the student, both the value of the subject matter, and the need for consistent work if the subject is to be mastered. If a difficult subject is sympathetically presented, much of its mystery disappears, and the student is enabled to make much better progress.

The ideal teacher knows that coöperation begets reciprocal action from those with whom he has dealings; hence, he takes pains to build up such relations both with his students and with his fellow faculty members.

He knows also the value of teamwork, therefore he submerges his own personal likes and ambitions to help further the educational movement of which he is part. This same knowledge prompts him to do his utmost to bring experimental work, even though it has been suggested by someone else, to a successful conclusion.

Coupled with all of the foregoing, must be a thoroughly sympathetic understanding of human nature, in order to be able to recognize the failings of the student and to devise ways and means to assist the individual to overcome his weaknesses. To do this properly, the ideal teacher must possess the ability to decide quickly, when to make allowances, and when to act with firmness without giving the appearance of vacillation.

When such a teacher finally gets into a supervisory or administrative position, he again stands forth as a man who has definite ideas on how the educational machinery should be operated, and yet is willing not only to listen to the ideas which his teachers may have on any phase of the subject, but is equally anxious to give credit where due.

Having outlined the general characteristics of the ideal teacher in an imperfect manner, the question still remains: Are there any such?

Applying the foregoing evaluating factors to the life of any teacher, would give one an estimate of how near that teacher approaches the ideal. The purpose of this editorial is to make this appraisal by judging the life of one who has recently departed — William C. Sieker, assistant director of the Milwaukee Vocational School.

Anyone who ever had any dealings with Mr. Sieker, even though casually, could not help being impressed with the sterling character and straightforwardness of the man. He not only preached honesty, but practiced it scrupulously. His instruction to his teachers with respect to their responsibility, were therefore strictly in accord with the precepts which he applied to his personal affairs when he ruled that materials lost due to the gross negligence of a teacher could not rightfully be charged to the taxpayers, but were to be paid for by the one who was at fault.

His personal diligence in performing his duties, and especially in preparing for the assembly periods which he voluntarily chose to conduct daily for many years, are above suspicion. In his statement to the teachers, his innermost feeling on this point was clearly reflected. "Any man who does not feel that he has the real missionary spirit in shouldering all the responsibilities that are implied in the work of a part-time vocational-school teacher, has no business to be on the faculty of such a school." His own reputation as science teacher was largely built on his willingness to devise and build rugged homemade apparatus in order that his students might the more readily grasp and understand the principles which he was demonstrating.

The same firmness that characterized him as principal conducting a large institution, no doubt characterized him also as teacher, but no decision as teacher or as principal was ever rendered which he was not willing to change if it could be proved that the premises upon which he had based it were not in accordance with facts.

Teamwork and service were his special slogans, and as a good leader, he showed their value in his personal conduct. Many an evening was spent at the school for no other purpose than to show some shortsighted parent the advisability to forego present higher wages in a nondescript job for the more secure future of a real trade learned by the apprenticeship method.

As is so often the case, one overlooks many of the good traits of those with whom one is in frequent contact, especially if these traits are mantled by a delightfully modest manner, but now that Mr. Sieker has passed away, those who knew him will more clearly see how nearly he measured up to being a real ideal teacher. Vocational education, too, will realize more and more that it has lost a very able champion.

VALUABLE HOURS

The remark is frequently heard that the part-time school idea is not based on very sound principles, because the time which the student must spend at school is entirely too short. What can a student do if he attends school 4 or 8 hours a week?

Probably this question can be quickly answered by asking another question. How much civic and moral damage is done by attendance for 2 hours a month at a club which disseminates antisocial propaganda? Everyone can readily see that 2 hours a month spent in this way would have a most pernicious effect. Why then should 8 hours a week spent in real honest-to-goodness study of civic and industrial facts and information not have a profitable result?

Of course, teachers of the part-time school must be thoroughly keyed up to their responsibilities in making this short-time contact truly valuable. They

must see their possibilities to arouse new interests, discover aptitudes, fire ambitions, affect lives, and mold characters. They must realize that every moment of the time must be profitably spent in order to make efficient use of the time for which the compulsory-attendance law makes the student sacrifice time and probably money. Classwork, for this reason, must be thoroughly analyzed. There must be no lost motion in getting started or in carrying on the work. The student's interest must be aroused and sustained throughout the entire contact between him and the school. It is only in this way that the part-time vocational school will efficiently solve its problem, and to the doubters who fear that this type of education is not valuable, be it said that the efficiency of the part-time school is continually increasing because of the thoroughness with which the educators intrusted with this type of work are analyzing and organizing their work.

THE HISTORICAL MOTIVE

Very often an everyday job which has little or no appeal to the student can be made very much more interesting by giving it special importance through the use of historical materials in its construction.

The use of wood taken from buildings, trees, ships, or other structures of historical value in the making of gavels for the presiding officers of different organizations, is not at all a new procedure. Very few of them, however, embody so many different materials of historical import as the gavel which Mr. Clarke A. Fulmer, state director of vocational education, Lincoln, Nebraska, has prepared in the Lincoln schools, to be presented to Mr. J. B. Hobdy, of Alabama, at the American Vocational Association convention which was held at New Orleans.

Because of the interesting features embodied in this particular gavel, a description of it follows. No doubt, it took a great deal of effort to gather all of the materials that were used, but the labor undertaken turned the hackneyed turning problem of a gavel into a project so rich in historic value that the students felt proud to have some part in its making.

The head of this gavel is made of wood taken from a black-walnut tree that grew on a ¼ section of land on which was located Homestead No. 1, claim for which was filed on January 1, 1863, at the Government Land Office located at Brownville, Nebraska. The handle of the gavel is made of wood taken from an apple tree planted by Wm. Jennings Bryan on his Fairview farm located at Lincoln, Nebraska. The letters V. E., standing for "vocational education," were inlaid with red-cedar wood obtained from the home of J. Sterling Morton at Nebraska City. The background for these letters is inlaid with ash taken from the balustrade of the new Nebraska State Capitol.

On the other end of the gavel head the letters J. H. (J. Hobdy) are inlaid with oak obtained from a mantel in the house which for many years was the home of General John J. Pershing at Lincoln, Nebraska. The background for these letters consists of stained pine taken from a house in Lincoln in which General Charles G. Dawes and Mrs. Dawes set up housekeeping in 1889. The handle is girdled with three rings, the one nearest to the head is inlaid with a piece of oak taken from a very early trading post built at Bellevue, Nebraska. The second is made of cottonwood taken from a tree which grew just halfway between the Atlantic and the Pacific Oceans. The third is of wood taken from an old flagpole which did service at Fort Kearney in 1848. Opposite the handle in the head of the gavel are three concentric rings, the first made of a piece of truss rod taken from the first Union Pacific railway Company's passenger coach that was operated west of the Missouri river. The second is made of a cartridge found at Fort McPherson. The inner ring is made from the horn of a buffalo killed by William F. Cody (Buffalo Bill), and the plug within the three rings is made of balsa wood taken from a piece which was left in the basement of the house in which Col. Charles A. Lindbergh roomed during the months spent in Lincoln in 1922 while he was learning to fly.

On each side of the head there is inlaid a rectangular jewel which Dr. E. H. Barber, geologist and curator of the University of Nebraska, contributed. The one is, of course, belonging to the Tertiary period, the other is of the bone of a Titanopherium, a prehistoric animal belonging to the Eocene period. In order to perpetuate the historic value of this gavel, the handle contains a cavity which may be closed with a stopper at the outer end. In this cavity a copy of the description of the gavel has been placed.

NEAT DRAWINGS

A beautiful copy of a piece of antique furniture may be made from a sketch that is decipherable only to the builder of the piece himself, or it may be made from a drawing which is as beautiful in itself as is the piece of furniture which it pictures. Some teachers seem to feel that any time spent in beautifying a drawing is wasted. To them the actual making of the project is the big thing. The effect of a slovenly sketch on the student, however, can hardly be overestimated.

If neatness is demanded of the student, then the teacher must not fail in neatness himself. As a matter of fact, slovenly made drawings ought never to be tolerated in the school shop. If this is true, then no teacher should ever be guilty of making such drawings for his own use or for the use of his students. It is not a very difficult matter to learn the correct manner of making shop drawings. There is no excuse for using first-angle projections. They are not tolerated in mechanical-drafting rooms of this country, and the teacher should know the difference between a first-angle projection and a third-angle projection. He should naturally not allow his student to make use of these different methods of presentation, indiscriminately. To do so, means to borrow trouble. The dimensions on drawings ought to be plain and distinct to avoid errors, and there ought to be enough of them to satisfy all requirements.

Practice alone will make a person proficient in the art of lettering. Not everyone can become an expert at it, but everyone can practice until he has acquired a style of lettering which can be easily read. The standards which are placed before the students should at all times be of the very best, and the slovenly made sketches that are occasionally seen in the school shops should not be tolerated under any consideration.

WORK

Work thou for pleasure.
Paint or sing or carve
The thing thou lovest,
Though the body starve.
Who works for glory
Misses oft the goal,
Who works for money
Coins his very soul.
Work for the work's sake,
Then, and it might be
That these things shall
Be added unto thee.

—*Kenyon Cox.*

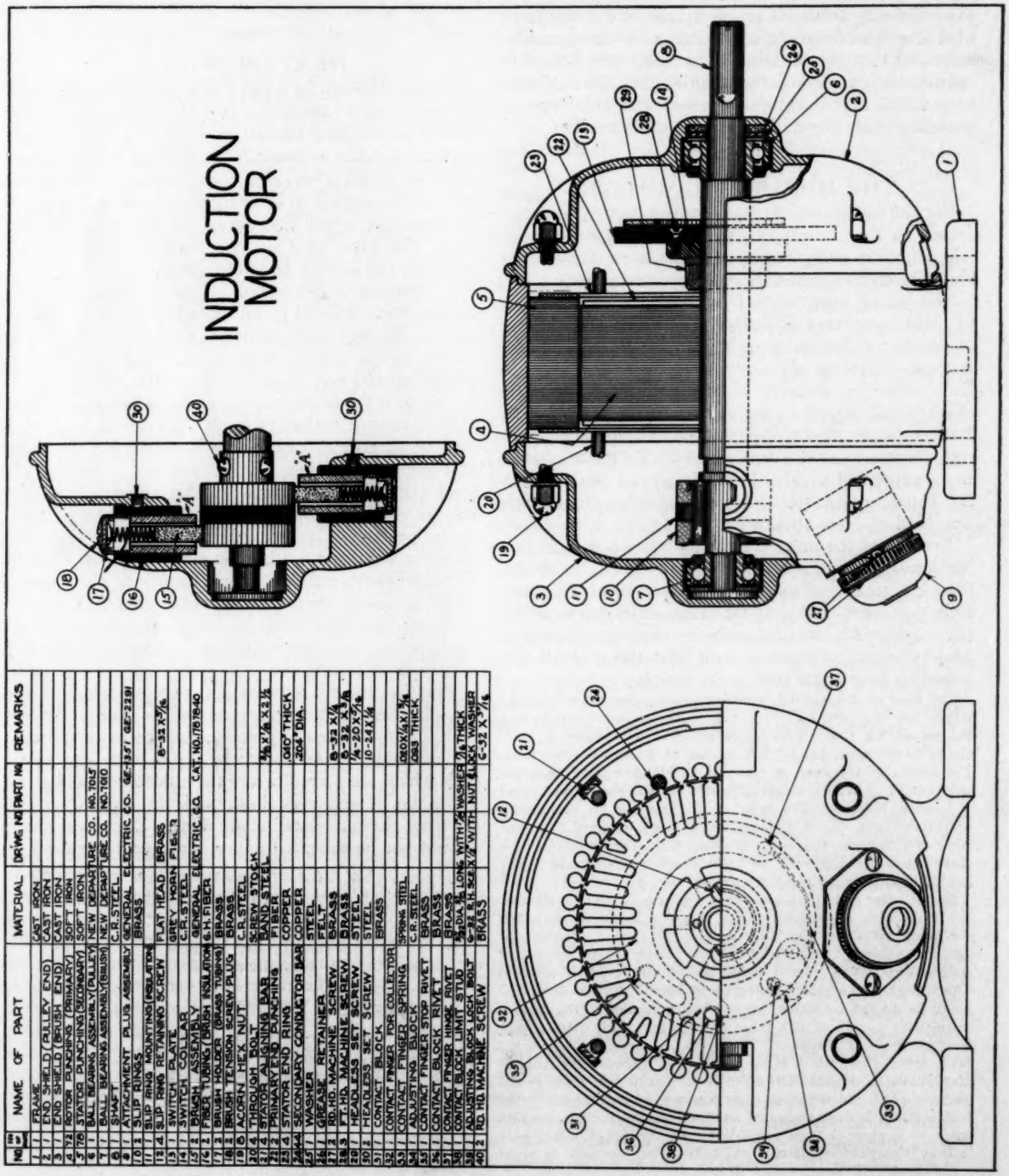
Construction Data for a ¼ H.P. Single-Phase Induction Motor

Clarence E. Crofoot *

ANYONE who has been connected with the teaching of electricity in a vocational or a technical school, will agree that there is an ever-increasing demand for some sort of a practical motor which students can build in the school shop or laboratory.

One of the first questions to consider in devising such a project is the type of motor to build. The factors governing this decision may be enumerated as follows: Can the motor be built in the average school shops without having to overcome serious handicaps?

*Head of Electrical Department, Utica Technical High School, Utica, N. Y.



NO. REQ'D	NAME OF PART	MATERIAL	DRWG. NO.	PART NO.	REMARKS
1	1	FRAME	CAST IRON		
2	1	END SHIELD (PULLEY END)	CAST IRON		
3	1	END SHIELD (BRUSH END)	CAST IRON		
4	1/2	ROTOR PUNCHING (PRIMARY)	SOFT IRON		
5	1/2	STATOR PUNCHING (SECONDARY)	SOFT IRON		
6	1	BALL BEARING ASSEMBLY (PULLEY)	NEW DEPARTURE CO.	NO. 1015	
7	1	BALL BEARING ASSEMBLY (BRUSH)	NEW DEPARTURE CO.	NO. 1010	
8	1	SHAFT	C.R. STEEL		
9	1	ATTACHMENT PLUG ASSEMBLY	GENERAL ELECTRIC CO.	GE-2391	GE-2391
10	2	SLIP RINGS	BRASS		
11	1	SLIP RING MOUNTING (INSULATION)			
12	4	SLIP RING RETAINING SCREW	FLAT HEAD BRASS		8-32 X 3/16
13	1	SWITCH PLATE	GREY HORN FIBRE		
14	1	SWITCH COLLAR	C.R. STEEL		
15	1	BRUSH ASSEMBLY	GENERAL ELECTRIC CO.	CAT. NO. 78/1840	
16	2	FIBER TUBING (BRUSH INSULATION)	G.E. FIBER		
17	2	BRUSH HOLDER (BRASS TUBING)	BRASS		
18	2	BRUSH TENSION SCREW PLUG	BRASS		
19	8	ACORN HEX. NUT	C.R. STEEL		
20	4	THROUGH BOLT	SCREW STOCK		3/16 X 2 1/2
21	1	PRIMARY END RING	#18 B.S. STEEL		
22	2	PRIMARY END RING	COPPER		.040" THICK
23	4	STATOR END RING	COPPER		.204" DIA.
24	4	SECONDARY CONDUCTOR BAR	STEEL		
25	1	WASHER	FELT		
26	1	GREASE RETAINER	BRASS		8-32 X 1/4
27	2	RD. HD. MACHINE SCREW	BRASS		8-32 X 3/8
28	3	FT. HD. MACHINE SCREW	STEEL		1/4-20 X 5/8
29	1	HEADLESS SET SCREW	STEEL		10-24 X 1/4
30	2	HEADLESS SET SCREW	BRASS		
31	1	CONTACT BLOCK			
32	1	CONTACT FINGER FOR COLLECTOR	SPRING STEEL		.010" X .4" X 1 3/4
33	1	CONTACT FINGER SPRING	C.R. STEEL		.093" THICK
34	1	ADJUSTING BLOCK	BRASS		
35	1	CONTACT FINGER STOP RIVET	BRASS		
36	1	CONTACT BLOCK RIVET	BRASS		
37	1	CONTACT FINGER HINGE RIVET	BRASS		
38	1	CONTACT BLOCK LIMIT STUD	1/4 DIA. 1" LONG WITH 1/4 WASHER		1/4 THICK
39	1	ADJUSTING BLOCK LOCK BOLT	C-32 R.H. SCR. X 1/2 WITH NUT & LOCK WASHER		
40	2	RD. HD. MACHINE SCREW	BRASS		C-32 X 3/16

ASSEMBLY DRAWING

Where can the necessary punchings and other parts, that cannot be successfully built at the school, be purchased? Under what conditions can these punchings be purchased? Does the type of motor lend itself to a winding which is practical, efficient, and which the average student can wind without difficulty and with a minimum amount of instructions? How many practical uses are there to which the motor can be put after it is completed? Finally, can the whole motor be built at a cost low enough to come within the reach of the average student or school shop?

Another question which arises, is: How much of the motor should the school plan to build? In the opinion of the writer, many schools make a fatal mistake when they attempt to build the whole motor. It is far more satisfactory to purchase standard punchings, and certain other parts, from some good manufacturer and build the motor around them.

The induction motor described in this article has been designed and built in the electrical and drafting departments of the Utica Technical High School. It has been designed so that any school possessing a good lathe, which will swing a 9-in. or 10-in. piece, can easily build it. If a shaper is available, some of the operations can be performed on it, but they also can be done at the bench if necessary. It does not require any special electrical equipment, and the specifications have been written with a view of handing them directly to the student to work from as would be done in an industrial shop. In order to meet the requirements of good electrical and magnetic design and to be able to purchase standard punchings, switch parts, bearings, etc., the whole design has been worked up around the General Electric Company's punchings for a standard ¼-h.p., 60-cycle, 110-volt, 5.4 amperes, 1725-r.p.m., 40-deg. C. continuous-rating, single-phase induction motor. It is also designed to use the new "En-D-Seal" type of New Departure ball bearings, as they are easy to mount and maintain.

Anyone desiring to build this motor can secure all necessary blue prints, winding specifications, punchings, switch parts, attachment plug and ball bearings made up in kits by applying directly to the General Electric Company's Educational Sales Department, through their nearest local sales office. The castings for the frames and end shields can be purchased from the Clayville Foundry Co., Clayville, N. Y., near Utica. The necessary wire, insulation, etc., can be purchased through your local electrical jobber. The whole motor can be built at a cost, for material, of from $6.50 to $7.

The directions for winding and machining this single-phase, a.c. motor, rated at ¼ h.p., 60 cycles, 110 volts, 5.4 amperes, 1725 r.p.m., 40 deg. C., continuous rating, are contained in the following:

Assembling the Rotor Punchings

A considerable amount of care should be observed in the assembling of the rotor or a poor motor will result. Unless the punchings are carefully stacked and well clamped, the motor will be noisy and it will also give a great amount of trouble in the way of insulation failure after it is put into operation.

First, see that you have the proper amount of iron. There should be 72 steel punchings, as shown under item No. 4 of the assembly drawing, and 2 fiber end punchings of item No. 22.

Next, turn up an arbor or assembling jig, as shown in Figure 2. This will serve to clamp the punchings firmly together and to provide an axle for the rotor while it is being wound. In assembling the punchings, first put on one of the fiber punchings and then the steel punchings, being sure to have them all the same side up and with slots to match. This is easily done by watching for the little marker at A in Figure 1, and the smooth side of the punching. After the punchings are all assembled with the second fiber on last, they should be well clamped down with the nut on the arbor. However, before doing this, it will be necessary to make up one or preferably two hardwood wedges which will just fit the slots B and C in Figure 1. This will make it easy to correctly align the punchings and to hold them in the proper position while tightening down with the nut.

Before clamping down too much, be sure to stagger the slots, as shown in Figure 6, by twisting on the two wedges until they stagger just one slot width, as shown at A in Figure 6. This can also be seen in Figure 7, which shows a rotor partially complete. After the punchings have been properly arranged, clamp them as tightly as possible. Check up on the edges of the slots to see if they are rough. If they are, they should be smoothed down with a thin file.

After this is done, the rotor is ready for the slot insulation and winding.

Winding the Rotor

First, cut the slot insulation for the rotor. For the best results, use either fish paper or rawhide fiber insulation of 0.008- to 0.010-in. thickness. Either plain or oil-treated stock will do. This fiber cell should be lined with varnished cambric insulation of 0.005 to 0.007 in. If the insulation is too thick, trouble will be experienced in getting the coils into the slots.

In cutting the paper insulation, it is necessary to have the cells fit the slots accurately if you desire a neat job and one that can be easily wound. Cut the length, so that it is $\frac{1}{16}$ in. longer than the length of

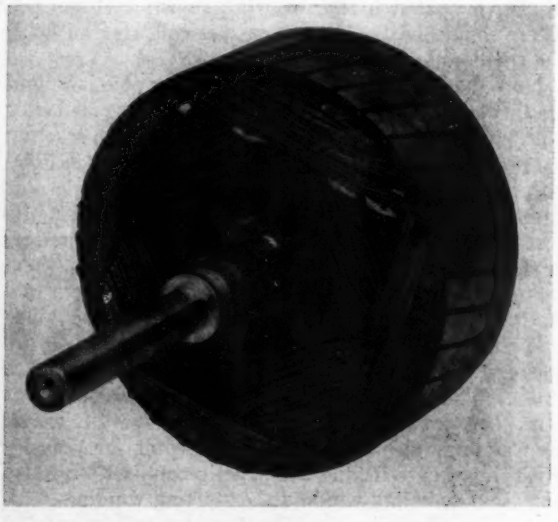


FIG. 7

the slots or width of the rotor. In width, the insulation should fold so that the two edges come just to the top of the slot, as shown at D in Figure 1.

The cambric insulation should be cut to the same length as the fiber cell, but the width should be greater so that the two edges will project out of the slot, as shown at E in Figure 1. This will serve two purposes: first, by projecting, it is easy to hold it from wrinkling down with the wire, and second, it will help to protect the insulation on the wire from being injured by the rough edge of the slot as the wires are laid in. After the slot is filled, this extra cambric should be cut off flush with the iron and the two edges folded in, to cover the wire under the wedge.

The wedges for holding the coils into the slots can be cut from ordinary red-fiber stock of 0.015- to 0.020-in. thickness, or preferably from gray horn-fiber. These wedges should be at least $\frac{1}{8}$ in. longer than the length of the slot and $\frac{5}{32}$ in. wide. In some cases, they may have to be slightly narrower for the small slots in which the starting winding is placed.

Running Winding

The second step will be the actual winding of the rotor, as shown in Figures 3 and 4. Figure 3 shows the method used in winding the running winding and its location with reference to the large and small slots.

When starting the winding, be sure to use a good cotton sleeve over the wire at A in Figure 3 and fasten it at the slot. This lead should be at least 4 or 5 in. long so as to provide plenty of wire to reach to the slip rings which are shown under item 10 in the assembly drawing. The direction of the winding is shown by the arrows, and the number of turns for each running coil or slot is indicated by the figures at the slots in Figure 3. The coils are graduated in size to fit the slots and at the same time provide for the most economical use of the iron. The short coil should be wound first, as indicated, and starting on the side of the rotor which you wish to assemble toward the slip rings.

The running winding is wound with .042-in. No. 18 B. and S. in either enamel cotton or double cotton-covered wire. The number of turns per coil varies and is also indicated in the drawing shown in Figure 3. There should be 19–23–30 turns per coil, starting with the small coil of the groups.

Note that every other group of coils or pole is wound in the opposite direction to obtain proper polarity without cutting the wire between coils. When starting a new group or coil, the wire should be insulated by covering it at the point C in Figure 3 with a piece of cambric or treated paper to prevent shorts when the rest of the coil is wound on and pressed down over it at C. In winding the coils, be careful to spread them out flat, as shown in Figure 7. Do not let them pile up too much or they may interfere with the slip rings and starting switch. This can be accomplished by keeping the wires parallel and not allowing them to cross. When finishing the last coil, allow plenty of wire for a lead and use a cotton sleeve for the lead B as was done also at A. Check the rotor for polarity with direct current and a magnetic compass, and also for grounds before winding the starting winding.

The Starting Winding. The next step will be to wind the starting winding as shown in Figure 4, which is made up of four coils per pole instead of three as used in the running windings. This winding is wound in the small slots or in quadrature with the main winding in order to provide the proper phase displacement for starting.

The second winding should be insulated from the main coils by at least a single layer of .005- to .007-in. empire cloth or varnished cambric, both in the slots, occupied by both coils, and at the ends of the slots or point C, Figure 4, where the starting and main coils cross. This insulation and the relative position of the starting and running coils can be clearly seen in Figure 7. The insulation can be cut a little large and trimmed to fit the coil after it is wound. Use cotton sleeves at the points A and B as on the main coils and allow plenty of wire for leads.

The starting winding is wound with .020-in. B. and S. No. 24 in either enamel cotton or double cotton-covered wire. The number of turns per coil varies and is indicated in the drawing shown in Figure 4. There should be 10–15–16–10 turns per coil, starting with the small coil. As fast as the coils are completed the cambric insulation should be trimmed down and folded in, so that the wedges can be driven in over the coil and the rotor completed as far as the winding has progressed.

After both windings are complete and have been tested for polarity, grounds, and shorts between coils, the arbor or assembling jig should be removed and the rotor pressed on the shaft, being careful to locate it in the center of the shaft so that it will be in proper alignment with the stator.

Assembling the Slip Rings and Starting Switch

Slip-Ring Assembly. After the slip-ring assembly has been made up according to the drawing, it should be pressed on the shaft. In doing this, be sure to have the two contact screws or connecting points turned so that they will be in line with the leads which come from the windings of the rotor and thus provide for a neater and easier connection. The little groove in the shaft is to prevent the contact screws from shorting by touching the shaft. It may help to fill this groove with insulation, such as fish paper.

Starting-Switch Assembly. In assembling the starting switch, considerable care must be observed in riveting items 31, 32, 34, to the fiber disk, shown in item 3 on the detail sheet, and not upset the rivet so much as to make the parts bind. The little washers listed under item 12 on the detail sheet are to serve as spacers to hold the above items out from the fiber far enough to insure free operation of the switch. When this assembly is completed according to the specifications shown in the detail and assembly drawings, it should be put on the shaft, and after being adjusted to the best position for making the winding connections, it should be secured with the setscrews. Make sure that the contact blocks and collector finger are assembled properly so that they will move freely enough to make a contact with each other. The contact finger springs should be adjusted so that the finger will throw out at about $\frac{3}{4}$ of the full speed.

Final Connections on Rotor

The Main Winding. First apply direct current to the main or running winding through a test lamp, and

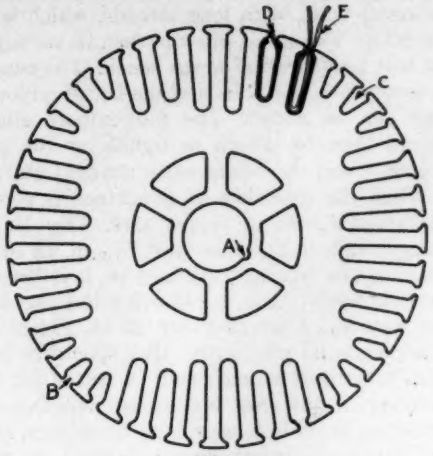


FIG. 1
ROTOR PUNCHING

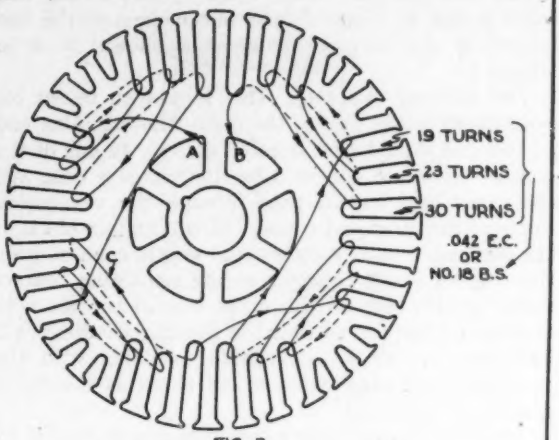


FIG. 3
RUNNING WINDING

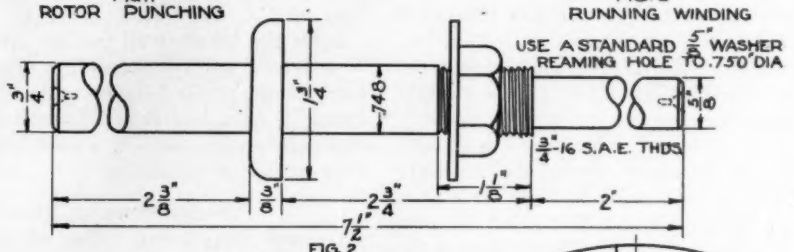


FIG. 2
ASSEMBLING ARBOR

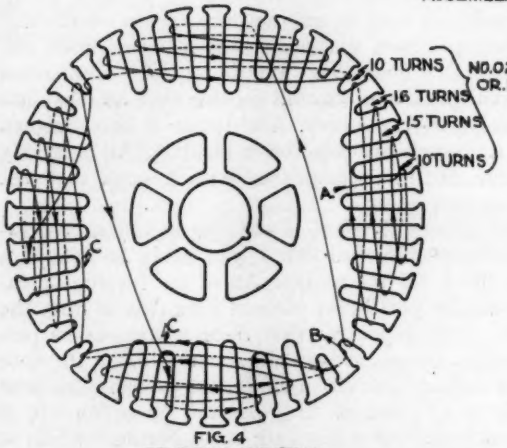


FIG. 4
STARTING WINDING

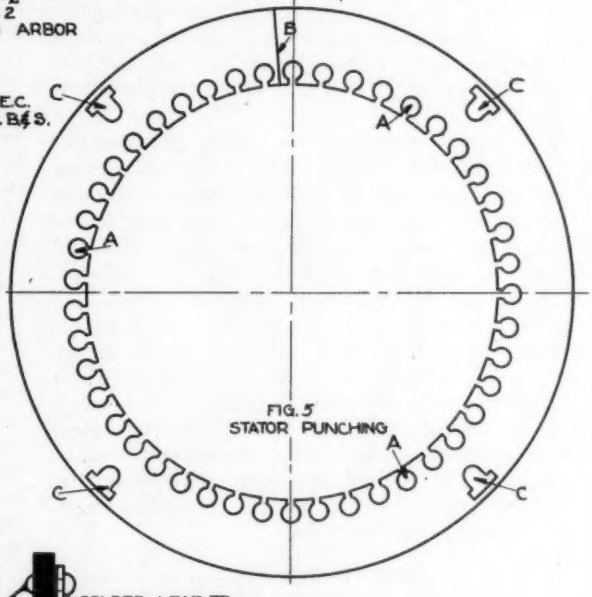


FIG. 5
STATOR PUNCHING

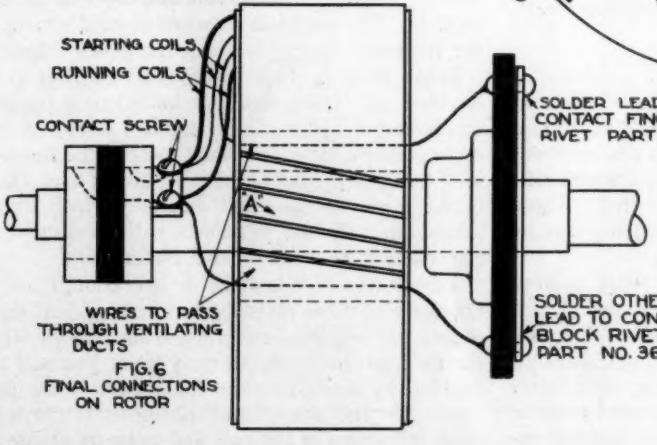

STARTING COILS
RUNNING COILS
CONTACT SCREW
A
WIRES TO PASS THROUGH VENTILATING DUCTS
SOLDER LEAD TO CONTACT FINGER RIVET PART NO. 37
SOLDER OTHER LEAD TO CONTACT BLOCK RIVET PART NO. 36

FIG. 6
FINAL CONNECTIONS ON ROTOR

DETAILS OF INDUCTION MOTOR

check the rotor with a magnetic compass, for polarity. When this has been done, make eyelets in the two leads A and B, Figure 3, and fasten them to the two screws in the contact block, as is shown at A in Figure 6.

The Starting Winding. This should be tested for polarity as in the case of the main winding. One end of this coil should be connected directly to one of the contact screws in Figure 6 for the one slip ring, and the other lead should pass through the ventilating ducts of the rotor and connect to the contact block of the starting switch. Another lead should connect from the contact finger collecter to the remaining contact screw or slip ring on the other side of the rotor as shown in Figure 6, so that the starting windings will be connected across the running winding with the centrifugal starting switch to cut it out as the motor attains full speed.

The leads through the rotor should be carefully insulated and lashed down to prevent the insulation from chafing off, thus causing shorts.

To Reverse Rotation. The rotation may be reversed by reversing the two starting leads at the contact screws or slip rings.

Final Insulation. After all connections and tests have been made, the windings should be carefully treated with an insulating varnish such as G. E. No. 450 clear baking compound and baked in an oven for 8 to 10 hours at 100 to 120 deg. C. This will bind the coils into one solid mass which will not only insulate them, but will serve to hold them from vibrating or flying out of place. It will also make them more or less oilproof.

If there are no provisions for baking them, an air-drying varnish such as G. E. No. 152 clear air-drying varnish compound may be used. An ordinary portable gas oven over a single gas flame will do a good job of baking. After the rotor is completely assembled and insulated, it should be carefully tested for balance. Usually it will be sufficiently accurate for smooth operation. However, it is difficult for some students to produce an even winding and it may be necessary to do some balancing. The balance can be tested on a couple of V strips or balancing ways, or by using a couple of leveling blocks and letting the rotor rotate in the ball bearings after they are pressed on the shaft.

If balancing is required, it may be accomplished by forcing pieces of lead tubing into the ventilating ducts. Do not close the ducts entirely.

Stator Assembly

Assembly of Punchings. First take one of the iron punchings and a hardwood board about 7 in. square and, using the punching as a guide, locate 3 holes about 120 deg. apart and insert small steel pins which will slide readily through the holes at A, Figure 5. These pins should then be driven into the board to serve as a guide in assembling the punchings.

First lay on two of the copper end rings making sure that the cut or ends shown at B, Figure 5, are staggered so as not to leave an open circuit. Next, assemble the iron punchings, being sure to get them all right side up. You can tell this by feeling for a small "burr" left by the punch. When the required number of iron punchings has been stacked, add the two remaining copper end rings. One can then insert about six small bolts, with long threads, which will just fill the holes. The whole pile can then be turned over with the bolt heads resting on the bench. The punchings will slide down on the bolts and the board removed so that nuts can be added. The four square aligning bars should then be driven in tightly at the point C in Figure 5 and the whole stack drawn tightly together.

When the assembly of punchings is complete, cut 44 bars of 0.204 bare copper wire. They should be cut long enough to allow at least $\frac{1}{16}$ in. at each end for heading. In driving these bars in, it is better to use a rawhide mallet so as not to upset the bars before they are way in. After they are all in, except where the clamping bolts are located, they should be peened over with a hammer at each end. A better job will result, however, if the ends are coated with No. 293 G. E. soldering paste before peening them over, since it will aid materially when sweating them in with solder later on.

After the bars are all peened over, the 6 bolts may be removed and the remaining bars inserted. All the bars should be thoroughly soldered or sweated in, to insure a good electrical contact. Failure to do this thoroughly will result in a poor motor. The stator is then ready for machining.

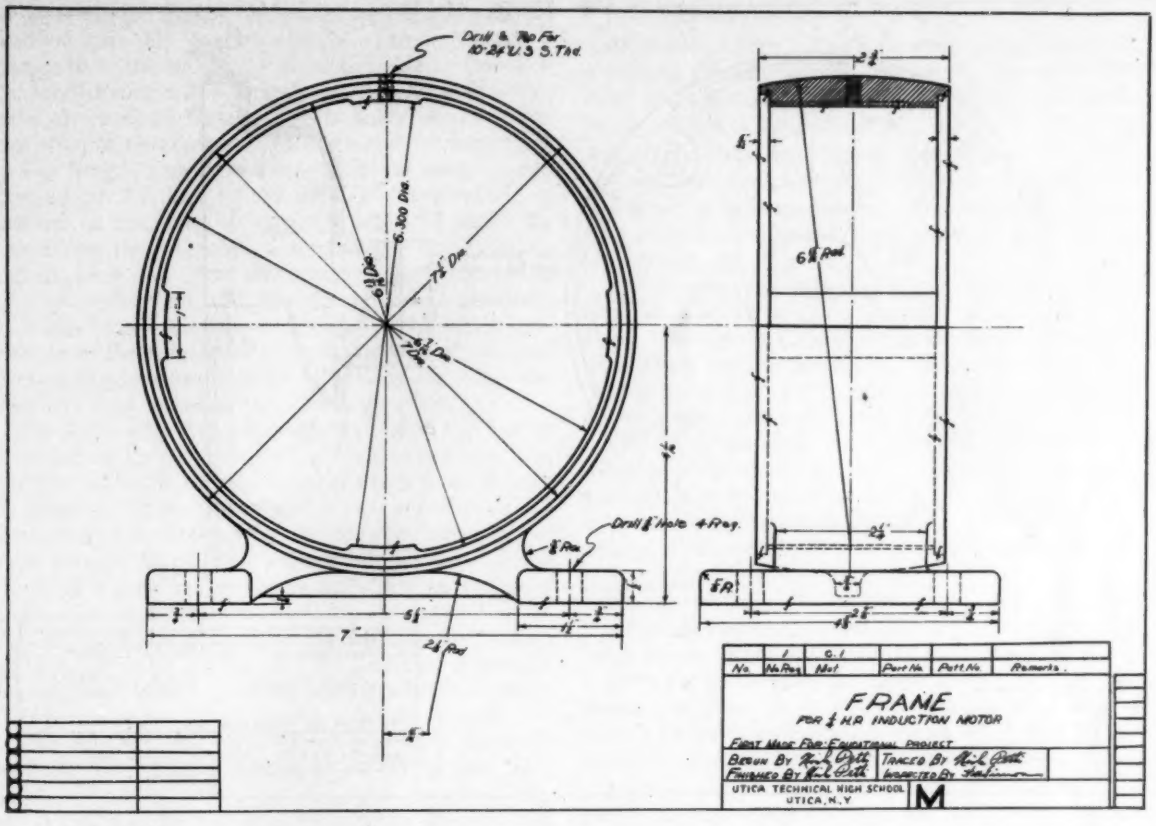
Suggestions on Machining

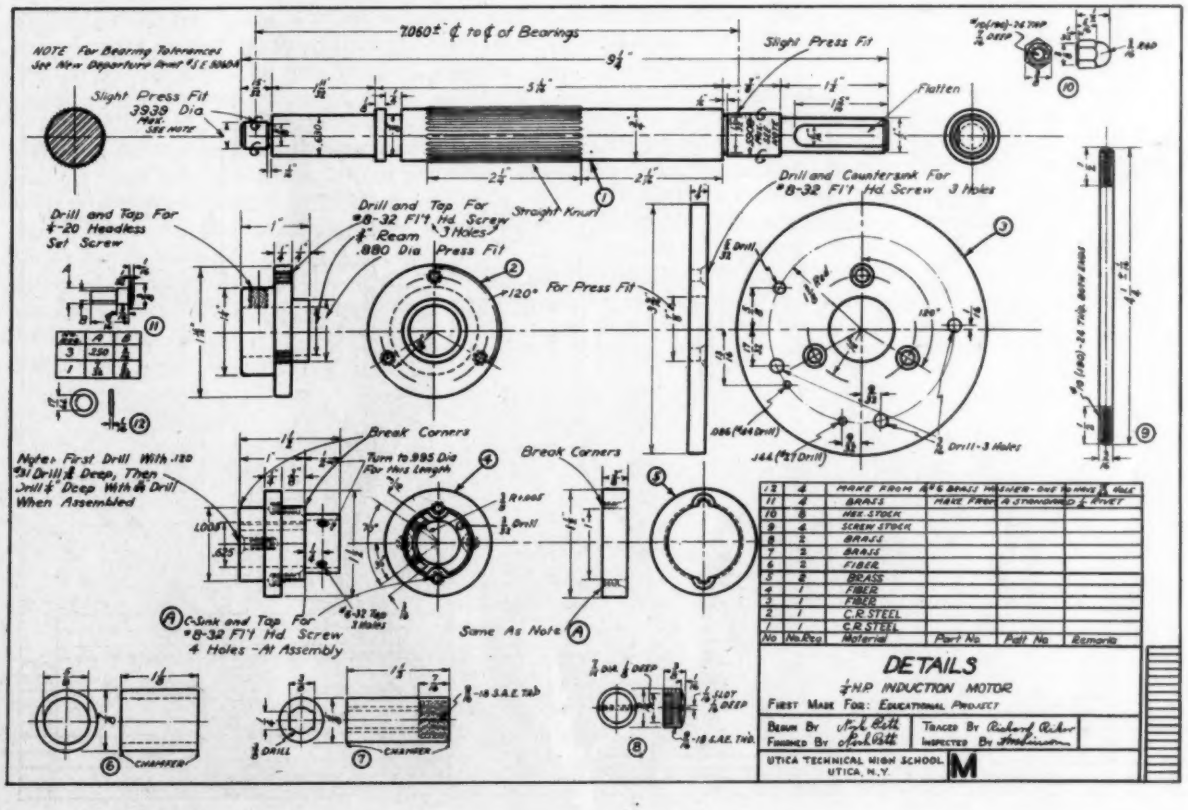
General Suggestions. The whole design has been worked out with a view of producing a motor which can easily be built in any machine or electrical shop, which is provided with an ordinary engine lathe and the necessary tools to go with it. A small arbor press and drill press will also aid consideraby, but they are not absolutely necessary. The frame is also designed so that no cores are required in molding. All necessary grinding can be accomplished with a small tool-post grinder in a lathe.

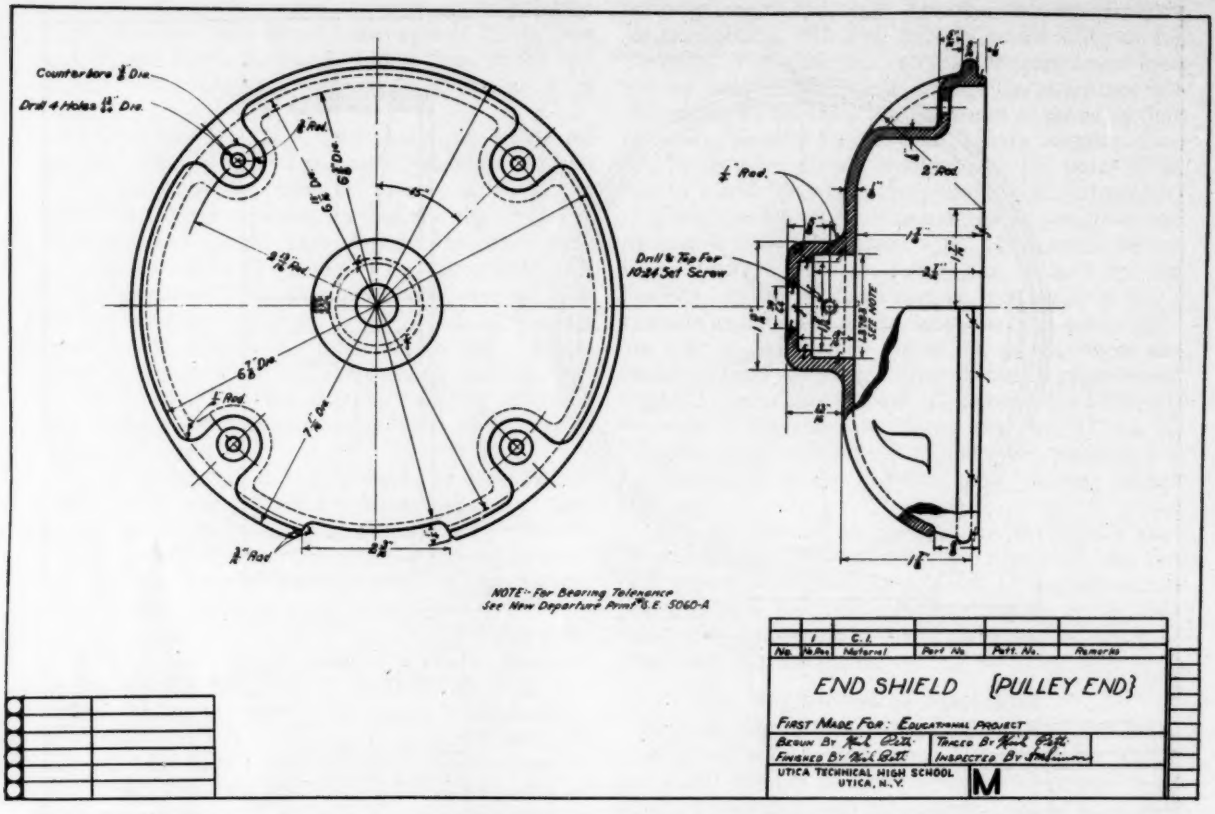
End Shields. The hub of the end shield has been extended and shaped so that it can easily be held in a lathe chuck for machining. All of the turning operations can be performed without removing it from the chuck. It is important that these operations be performed at one operation, as indicated, for if they are not, it is most difficult to obtain the perfect alignment which is so essential to successful operation. It is necessary to be very accurate about boring the hub or bearing housing so that the bearing will have a nice push fit. The machining should be held strictly within the tolerance limits shown in the detail drawings.

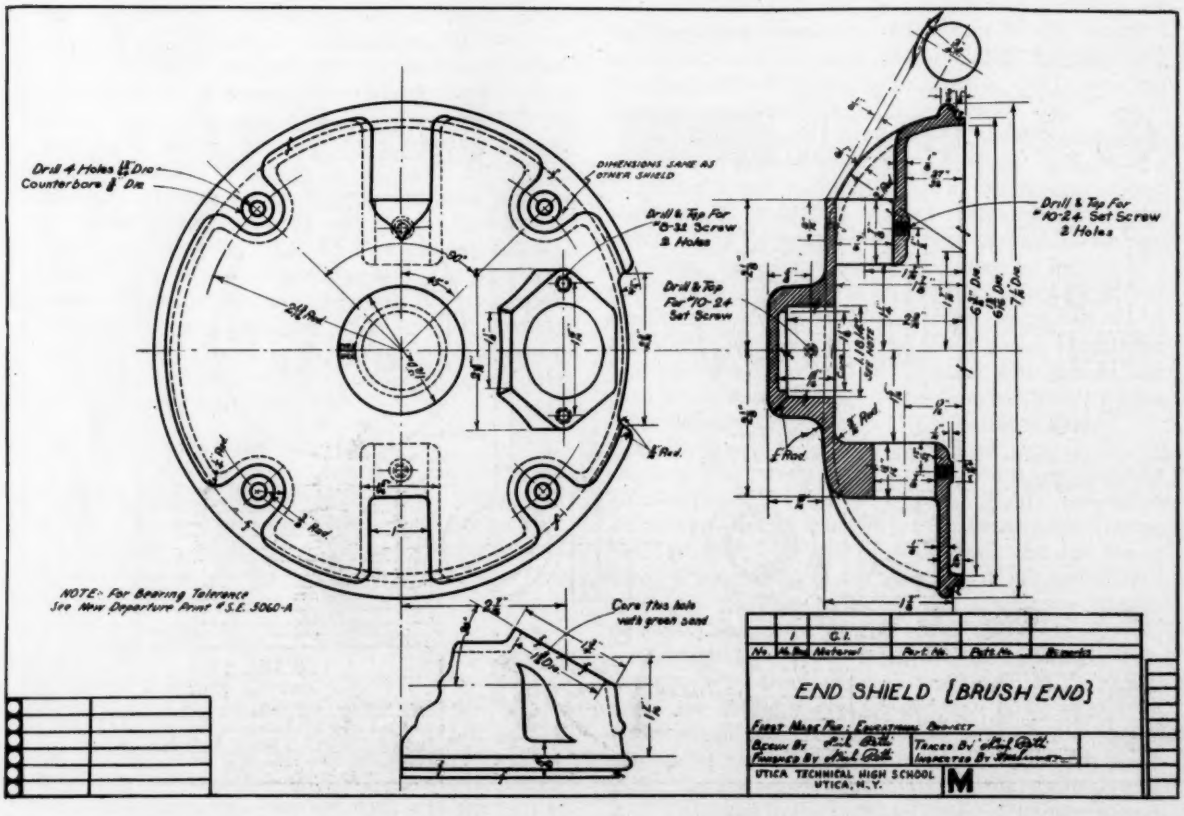
Main Frame. This is designed so that it can be chucked in a lathe chuck or bolted to a faceplate for machining one edge to take the end shield. A template or faceplate can be machined to take the finished edge and the other side can be machined and the frame bored to receive the stator assembly which, unless well pressed in, will have to be held with a setscrew through the frame to prevent turning under load.

The Shaft. This is a simple operation, but considerable care must be observed in finishing it at the points where the bearings are pressed on. Hold strictly to the fit given in the detail drawing or you will ruin the bearing by stretching the inner race if the fit is too tight. On the other hand, if the fit is too loose, the shaft will creep in the race and cause an undue amount


Drill & Tap For 10-24 U.S.S. Thd.
6.300 Dia.
6.8 Dia.
7½ Dia.
7.2 Dia.
6⅛ Rad.
Drill ⅜ Hole 4 Req.
⅜ Rad.
7"
5½
2¼ Rad.
FRAME
FOR ¼ H.P. INDUCTION MOTOR
FIRST MADE FOR: EDUCATIONAL PROJECT
UTICA TECHNICAL HIGH SCHOOL
UTICA, N.Y.
M


NOTE For Bearing Tolerances See New Departure Print #SE 8004
7.060± ℄ to ℄ of Bearings
9¼"
Slight Press Fit
Slight Press Fit .3939 Dia
Flatten
Straight Knurl
Drill and Tap For #4-20 Headless Set Screw
Drill and Tap For #8-32 Fl't Hd. Screw 3 Holes
⅜" Ream .880 Dia Press Fit
120° For Press Fit
Drill and Countersunk For #8-32 Fl't Hd Screw 3 Holes
Break Corners
Turn to .995 Dia For this Length
Note: First Drill With #31 Drill ½ Deep, Then Drill ¼" Deep With #8 Drill When Assembled
C-Sink and Tap For #8-32 Fl't Hd Screw 4 Holes - At Assembly
Same As Note A
DETAILS
¼ H.P. INDUCTION MOTOR
FIRST MADE FOR: EDUCATIONAL PROJECT
UTICA TECHNICAL HIGH SCHOOL
UTICA, N.Y.
M


Counterbore ⅜" Dia.
Drill 4 Holes ¹³⁄₃₂" Dia.
Drill & Tap For 10-24 Set Screw
NOTE:- For Bearing Tolerance See New Departure Print # S.E. 3060-A
END SHIELD (PULLEY END)
FIRST MADE FOR: EDUCATIONAL PROJECT
UTICA TECHNICAL HIGH SCHOOL UTICA, N.Y.
M


Drill 4 Holes ¹³⁄₃₂" Dia
Counterbore ⅜" Dia
DIMENSIONS SAME AS OTHER SHIELD
Drill & Tap For #8-32 Screw 2 Holes
Drill & Tap For #10-24 Set Screw
Drill & Tap For #10-24 Set Screw 2 Holes
NOTE:- For Bearing Tolerance See New Departure Print # S.E. 3060-A
Core This hole with green sand
END SHIELD (BRUSH END)
FIRST MADE FOR: EDUCATIONAL PROJECT
UTICA TECHNICAL HIGH SCHOOL UTICA, N.Y.
M

of wear on the shaft. The pulley end bearing should also be carefully located on the shaft to insure a proper fit in the end shield when assembled. Common cold-rolled steel will do for the shaft. Old automobile axles are excellent material for the shaft, however, and can often be obtained at little or no cost, from garages.

Slip Rings. The brass rings should be made up and pressed on the fiber before the slip-ring assembly is pressed on the shaft so as not to split the fiber. By assembling the rings first, a much better fit can be obtained, since the fiber will expand sufficiently, when pressed on the shaft, to tighten up the whole assembly. It is also better to solder in the short leads which connect from the rings to the contact screws of the connecting block before pressing the rings on, since the heat will tend to loosen them from the fiber.

The Rotor. After this has been varnished and baked, it should be turned, or better, ground to not less than 4.593 in. ± .002 in. being careful not to injure the coils in doing so. It is very necessary that the bore of the stator and the diameter of the rotor be accurate, as even a slight increase in the size of the air gap will result in a poor motor which will draw an excessive amount of current and overheat. The grinding or turning should be done before the bearings are pressed on to avoid emery getting into the bearings. All emery dust must be blown out of the windings after grinding. It is better to have a + tolerance than a — one.

The Stator. The stator should be very carefully chucked and ground internally to the proper size, which is 4.625 in. ± .002 in., leaving an air gap of 1/64 in. It can then be put on a template or mandrel and turned or ground to size on the outside. It also can be assembled and put into the frame without sizing and the necessary amount taken off from the rotor to secure the proper air gap. The first method, however, produces a much more accurate air gap.

Brush Holders. The brush holders have been designed to use standard brushes and also with a view of making them easy to construct. Standard fiber tubing, with an outside diameter of 7/8-in. and a 1/8-in. wall, can be used for the insulating tube, and the brass lining can be made from 5/8-in. solid-brass stock. It is intended to be drilled with a 3/8-in. drill and then broached out with a square broach to keep the brush from turning. It can also be made on a shaper or worked out at the bench with a file.

Points on the General Assembly

Attachment Plug. The attachment plug should be connected directly to the brushes by means of two short wires which can be soldered to the brass of the brush holders at the point A of the assembly drawing.

Bearings. In assembling the bearings or end shields, one must see to it that the bearing fits properly into the shield or bearing housing. This should be a good snug push fit, but not so tight as to cause trouble in assembling.

The bearings contain a sufficient amount of grease when shipped, for the first assembly or one year's run. These bearings must be kept in the original wrapper until ready for the assembly, to prevent them from taking up dirt and grit which would soon ruin the bearing when put into service. One should also be careful about handling the bearings with dirty hands, if the best results are desired. If accurately machined and properly assembled, a motor equipped with these bearings should run at least a year, under normal conditions, with one greasing, since the felt gaskets make it dust tight.

When the motor is greased again, a sodium-base ball-bearing lubricant should be used, if possible, since much better results will be obtained.

After the end shields have been drawn up, the rotor should run free. It is well to keep trying it as the shields are being pulled up. They should also be pulled up evenly to avoid cramping the bearings.

Brushes. When the main assembly has been completed, so that the rotor operates freely, the brushes can be adjusted. The spring tension must be adjusted so that a good contact will be obtained, but not too tight or it will overheat the rings and cause an extra friction loss.

It may be necessary to cut down on either the length of the brush or spring or both, since it is a rather short brush holder.

When making the first or trial run, pay special attention to the operation of the centrifugal switch, since its failure to function properly would soon result in a burned-out starting winding and possible damage to the main winding. This should cut out when the motor is from 1/2 to 3/4 full-load speed. If it does not do this, it should be adjusted by changing the tension on the spring which controls it.

EXAMPLES OF AMERICAN COLONIAL PEWTER AT THE METROPOLITAN MUSEUM OF ART, NEW YORK CITY

PROBLEMS AND PROJECTS

This department aims to present a wide variety of class and shop projects in the Industrial Arts. Successful problems are invited and will be paid for. A brief description of constructed problems, not exceeding 250 words in length, should be accompanied by a good working drawing. The originals of the problems in drawing and design should be sent.

Problems in woodworking, turning, patternmaking, machine-shop practice, sheet-metal work, forging, foundry work, auto mechanics, auto electricity, electricity, architectural and mechanical drafting, printing, bookbinding, concrete work, farm mechanics, home mechanics, and other lines of industrial-arts work are desired for consideration.

A SPINET DESK

F. M. Keith, Senior High School, Fort Smith, Arkansas

(See Supplement No. 165)

The spinet desk shown in the drawing has proved to be a popular project with the boys in advanced woodworking. It is of sturdy construction and is of great teaching value because it involves the use of practically every machine in the shop.

It is to be made of either walnut or mahogany and given a natural finish.

USEFUL INFORMATION ON MASONRY WORK

J. F. Faber and Fay Daley, Erie, Pennsylvania

(See Supplement No. 167)

In order to aid the student of architectural drafting in learning the symbols of masonry construction and the bonding of brickwork, the chart on "Useful Information on Masonry Work" was arranged.

The writers have found that few students have real understanding of the various bonds of brickwork, the joints used in laying them, or the types of stonework used in masonry work. A working knowledge of these things must be gained before any attempt is made to use them in construction.

Two types of arches were added as illustrations of lintel construction.

METAL END TABLE

C. J. Harper, Hillside High School, Hillside, New Jersey

The uses of metal are becoming more and more numerous in industry because it is cheaper and more durable than wood. Even our furniture is now being made of metal. Especially is this true of bedroom suites, desks, etc. When wrought iron is used, very attractive designs can be applied,

The novelty end table shown in the accompanying illustration, can be worked out and made by an eighth-grade student. It is a very interesting and attractive problem and the student can apply his own initiative to the design.

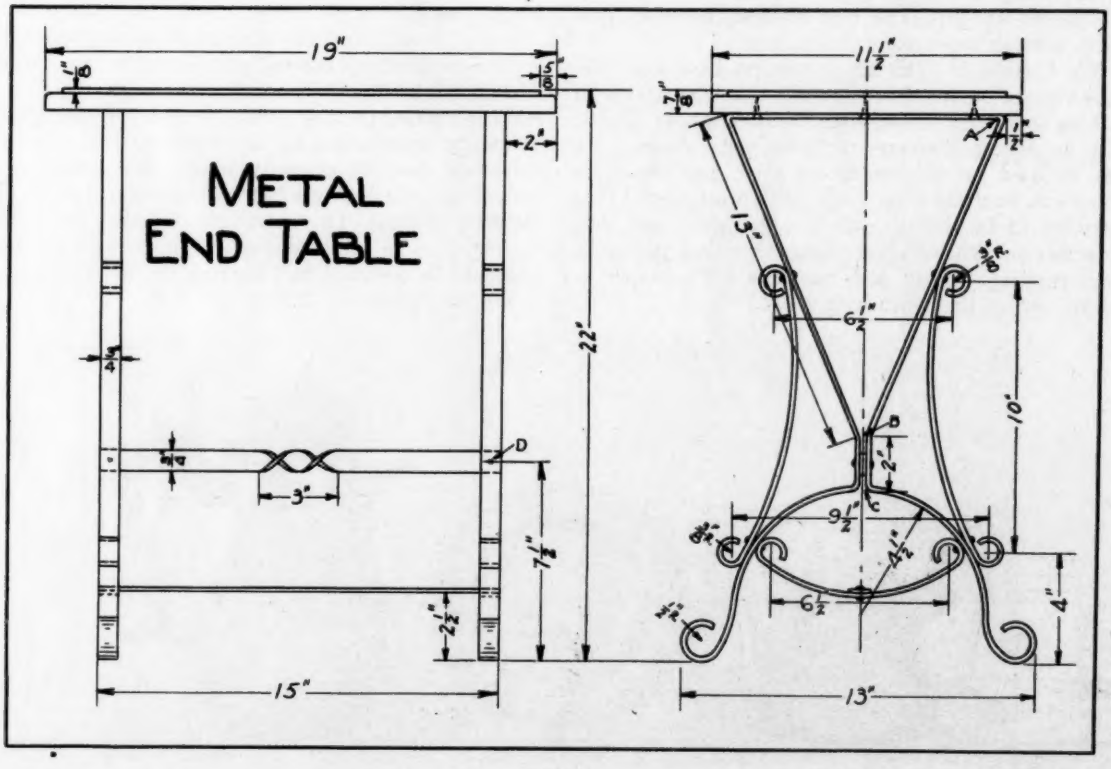
Procedure

Make the layout of the leg full size.

Cut two pieces 3/16 by ¾ by 63 in. for the legs.

Lay out and drill.

Bend the ends around a 1 ½-in. diameter rod or pipe.



Work from the center line, bend at A in the vise, being careful to have the scrolls on the outside.

Bend at B so that BC is parallel to the center line of the layout.

Bend at C to about 80 degrees.

Use a rounding hammer to round to the desired curve.

Cut two pieces 3/16 by ¾ by 15 in.

Make a full twist 3 in. long in the center of one piece.

Drill the holes ⅜ in. from each end. Use a No. 28 drill.

Rivet the pieces with the twist to each leg at D.

Cut two pieces ⅛ by ⅝ by 13 in.

Drill a No. 28 hole in the center of each piece.

Bend the ends around a ¾-in. diameter rod.

Round to the proper shape and locate the holes with an awl or a scriber.

Drill for a ⅛-in. rivet. Use ⅛ by ½-in. iron rivets.

Cut four pieces ⅛ by ⅝ by 18 in.

Bend the ends around a ¾-in. diameter rod.

Locate the lower holes with an awl or scriber, then drill.

Place the temporary rivets and locate the upper holes. Drill.

Rivet all the pieces to legs. Use ⅛ by ⅜-in. iron rivets.

Make a wood top ⅞ by 11½ by 19 in.

Rabbet the edge ⅛ by ⅝ in.

Sandpaper.

Square the lines across the underside 7½ in. from the center.

Place the body of the table on top and square up.

Use 1-in. No. 8 f.h. screws.

The top may be finished with lacquer, or it may be stained mahogany or walnut and given a rubbed varnish finish.

The ironwork is to be finished with a brushing lacquer and bronze powder blown on.

ASH-TRAY STAND

C. Forrest Felix, Garfield Junior High School, Johnstown, Pennsylvania

The ash-tray stand shown herewith was designed for the benefit of 7B students. These newcomers to the junior high school usually want to produce articles which are up to about the same standard as that maintained by the older and more experienced shop boys.

This project involves the use of the plane, try-square, compass saw, coping saw, backsaw, ripsaw, gauge, chisel, hand drill, screw driver, hammer, and sandpaper. It also involves the laying out and making of butt joints, dado joints, rabbet joints, and the assembling of the project with screws and nails.

The painting of the project is made interesting by using a mottled or sponge process. Lacquers or enamels may also be used.

Any fine-grained wood may be used for this project.

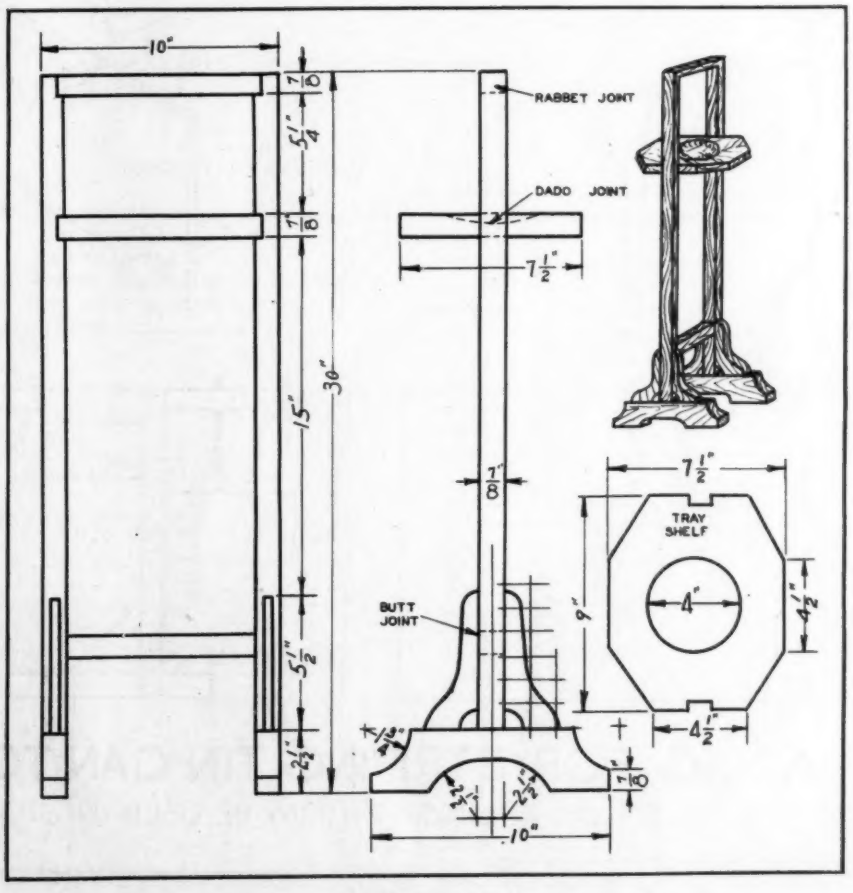
Bill of Material

2 pc. ⅞ x ⅞ x 28
1 pc. ⅞ x ⅞ x 9
1 pc. ⅞ x ⅞ x 8
1 pc. ⅞ x 7½ x 9
4 pc. ½ x 2 x 6
6 r.h. screws No. 8, 1¾ in. long
2 f.h. screws No. 8, 2½ in. long
1-in. brads

Study Drawing, Then Start to Worry

If the students are permitted to get out their own stock, they are likely to be more interested in the work.

The tray may be cupped out or not, just as one may desire. After the stock is cut to size, trued up, and sanded, take the two side pieces and lay out the rabbet joints for the handle



ASH-TRAY STAND

and the trap shelf; also lay out the location of the bottom brace bar. The handle is cut the same length of tray. The tray ends are laid out for dado joints to fit ⅜ in. around the side pieces. The bottom brace bar is then cut to fit in between the side pieces.

Fasten the foot, or bottom, to the side pieces with No. 8 by 2½-in. f.h. screws, then toenail the side pieces to the foot so that the side pieces are kept from turning. Nail the½-in. braces to the side pieces, and toenail them to the foot with thin brads. Use No. 8 by 1¾-in. r.h. screws to hold the bottom brace bar, tray, and handle in position.

Paint the finished project two coats of any bright color desired. Then take a small piece of sponge cut so as to have a flat surface. Dip this into a color which contrasts with the ground color and then pat it on the surface of the stand, covering the surface irregularly. Several colors may be sponged on in this fashion after the first color has set. The boys usually take great interest in applying this kind of finish, and parents express their pleasure over articles in the home which the boys refinished according to the directions given in the foregoing.

A JIG FOR STRIPING TIN-CAN TOYS

Charles Rice, North Junior High School, Everett, Washington

After a toy has been painted or enameled, a few stripes may be added for decoration. At this point a question arises on who should do the striping, the instructor or the student. The problem involved in the foregoing question should be solved in a manner that will allow the student to continue "on his own," if possible, until the project is finished. This can be done by building and using the simple jig shown herewith.

The Striping Jig

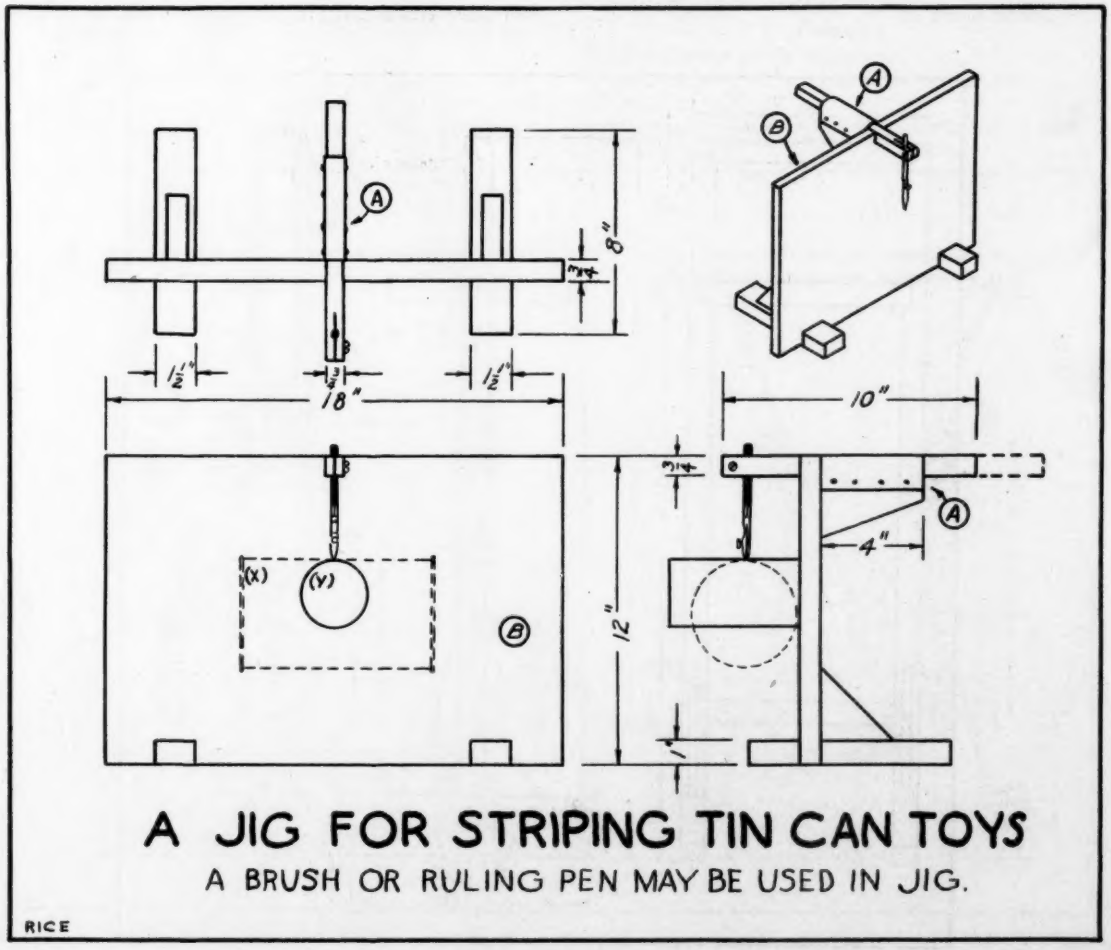
While it is not within the province of the average boy to do a good job of free-hand striping, fair results may be obtained by mechanical means. The brush or ruling pen is held rigidly in place by the jig, while the work is moved at will just as one might do while using a power saw. By way of illustration, the ruling pen or striping brush may represent a band saw while part B may be thought of as the table on which the work rests. In this case, however, the table is in a vertical position and the work must be held against that surface in order to guide the lines, Additional guides may be clamped to surface B if necessary, after the fashion of the "fence" used on table saws. Stripes may be run lengthwise by moving the object X along surface B as shown in the illustration, or the stripes may be made around an object, as shown at Y. The arm which holds the ruling pen or brush is held in place by a piece of sheet metal tacked over a block, as shown at A in the illustration.

Striping the Toys with Ink

The painted surface of the work should be wiped with a cloth impregnated with chalk dust. This will permit the ink to flow evenly on the surface. Black or colored waterproof ink should be used in the ruling pen. If wide stripes are needed, two lines may be made and the center filled in with a brush. The ink lines may be protected by spraying with white shellac or clear lacquer.

Striping with Paint

If paint or enamel is used for the striping, a striping brush should be used on the jig. The paint should not be allowed to dry on the brush or it will fail to "point up" for the next job. The brush will not harden if the tip is kept in machine oil when not in use.



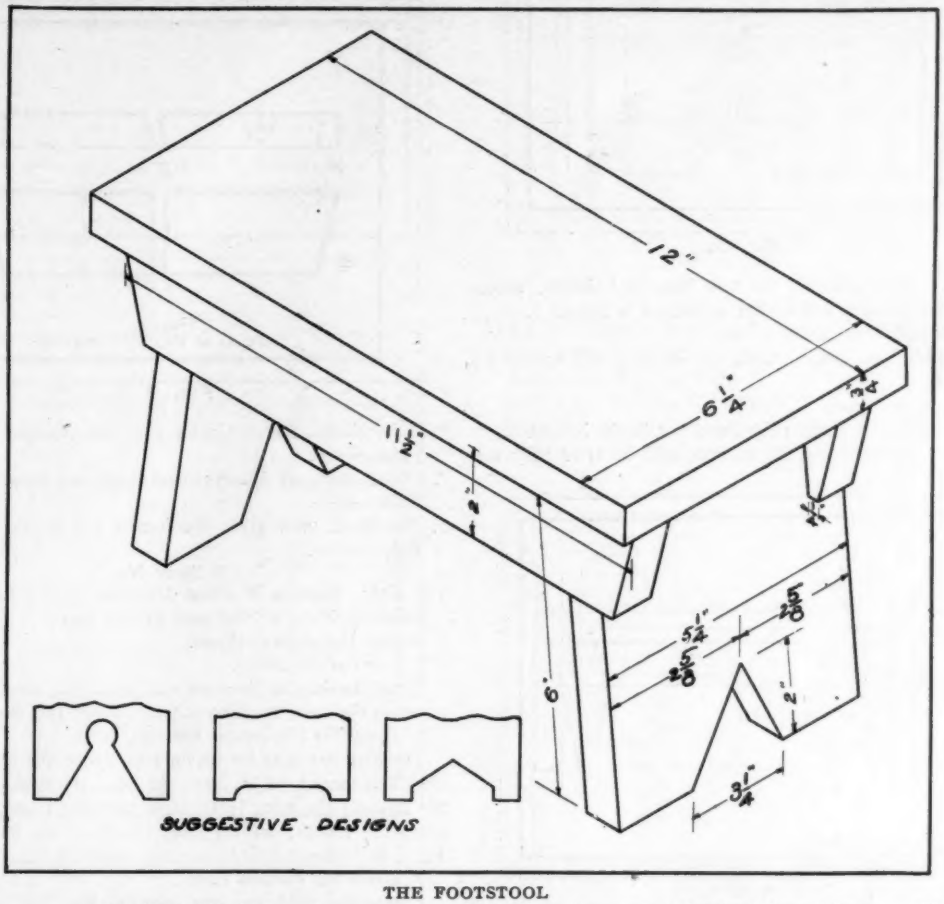
ADVERTISING PAGES REMOVED

A SET OF UNIT JOB SHEETS

Fred W. Megow, Junior High School, Wyncote, Pennsylvania

The project chosen for this unit is a Footstool.

The unit embraces four job sheets Nos. 1, 2, and 3 giving directions for making the required drawings for the project, and No. 4 giving directions for the actual construction work.



THE FOOTSTOOL

Job Sheet No. 1

The Job: Make a Working Drawing of the Rail shown in Figure 2. Show a front and a top view.

Follow the steps outlined.

1. Lay out the Sheet.

Draw the border lines on a 9 by 12-in. sheet of paper as shown in Figure 3.

2. Draw the Horizontal Lines.

Lay out the first 2 in. above the bottom border line; the second one 2 in. from the first; the third 1 in. from the second; and the fourth ¾ in. from the third. The dimensions for these lines were obtained from Figure 2. When all the horizontal lines are drawn, the drawing will appear as shown in Figure 4. The T square should be used for drawing the lines.

3. Draw the Vertical Lines.

Lay off the first lines 1 in. from the right-hand and left-hand border lines. Note that the distance between these two lines is shorter than the true length of the rail; hence, the views are to be shown broken. Draw the next two lines ½ in.

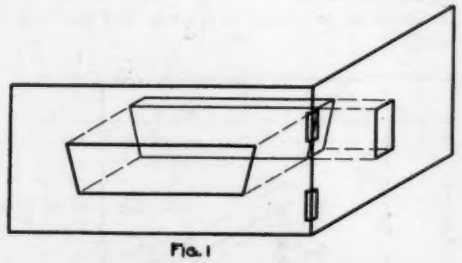


Fig. 1

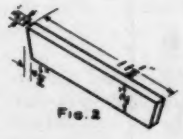


Fig. 2

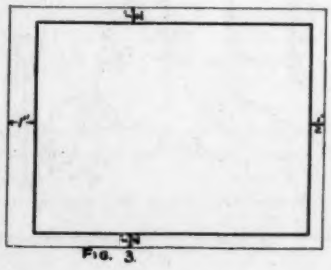


Fig. 3

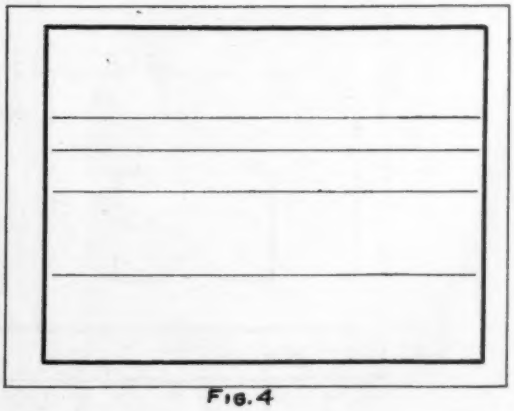


Fig. 4

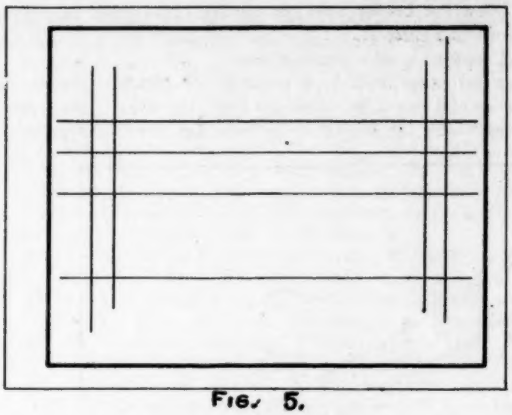


FIG. 5.

away from, and inside of, the two lines just drawn. When finished, the drawing will appear as shown in Figure 5.

4. Draw the Slant Lines.

When these have been drawn, the drawing will appear as in Figure 6.

5. Darken the Lines.

Before starting to darken the lines, put in the broken lines. Make them as heavy as the outlines will be after they are

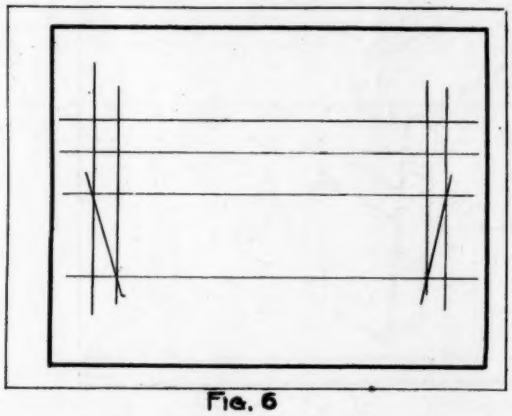


FIG. 6

darkened. Then darken the rest of the lines.

6. Put on the Dimensions.

These are shown in Figure 7. Be sure to make the dimension lines light. These lines should be at least ¼ in. from any other line.

7. Put on the Lettering.

Place the lower line of lettering ½ in. above the bottom border line, and make the letters and the spaces between the lines ⅛ in. high. Figure 7 shows how the finished drawing is to appear.

Test

Use a check mark to show whether you think the following sentences are true or false.

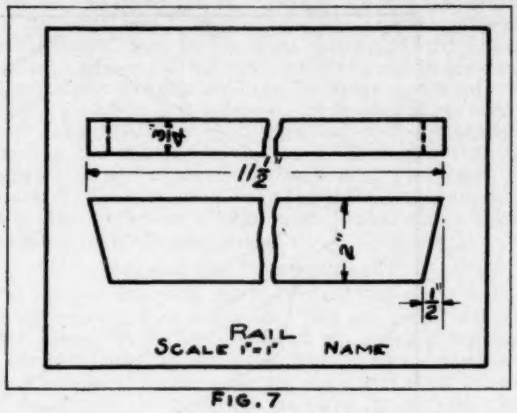


FIG. 7

1. A horizontal line is drawn with the triangle. True——— False———.
2. Object lines are heavier than dimension lines. True——— False———.
3. The front view gives the length and width. True——— False———.

Job Sheet No. 2

The Job: Make a Working Drawing of the Leg shown in Figure 2. Show a front and an end view.

Follow the steps outlined.

1. Lay out the Sheet.

Draw the border lines on a 9 by 12-in. sheet of drawing paper in the same manner as you did for Job No. 1.

2. Draw the Horizontal Lines.

The first one is to be drawn 1 in. above the bottom border line. The second, ⅛ in. from the first; the next, 3⅞ in. from the second; the next, ⅛ in. from the third; the next, 1¾ in. from the fourth; and the last, ⅛ in. from the fifth. (See Fig. 3.)

3. Draw the Vertical Lines.

Commence with the first vertical line. 1¾ in. from the left-hand border line. Then draw lines at the following disances apart; ¾; 3¾; ¾; 1; and ¾ in. (See Fig. 4.)

4. Draw the Slant Lines.

(See Fig. 5.)

5. Darken the Lines.

Draw these in as shown in Figure 6. Draw the broken lines neatly.

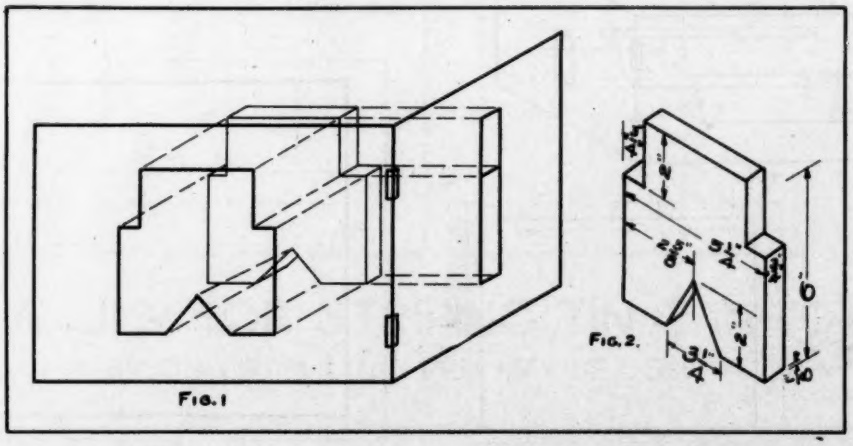


FIG. 1

FIG. 2.

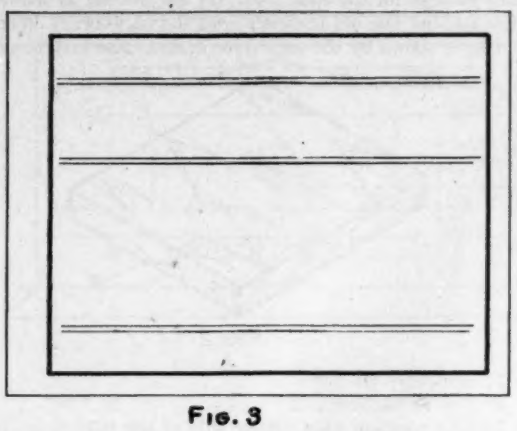


FIG. 3

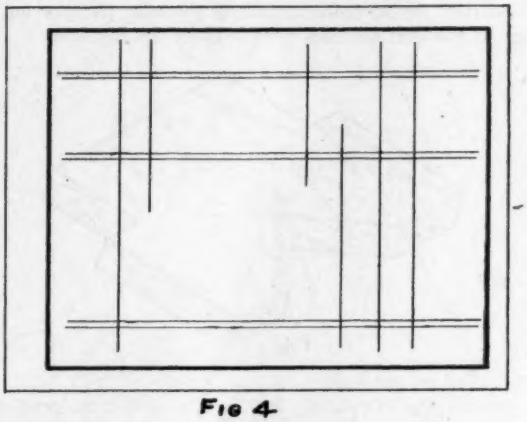


FIG 4

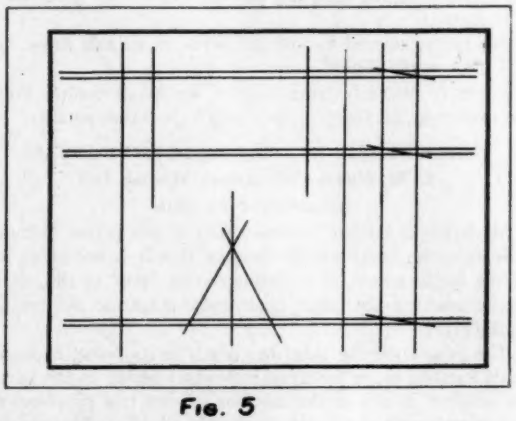


FIG. 5

6. Put on the Dimensions.
(See Fig. 6.)

7. Put on the Lettering.

Place the lower line of lettering ½ in. above the bottom border line, and make the letters and spaces between the lines ⅛ in. high. Figure 6 shows how the finished drawing is to appear.

Test

1. A Slant line is drawn free-hand. True——— False———.
2. The end view shows thickness and length. True——— False———.
3. The front view shows length and width. True——— False———

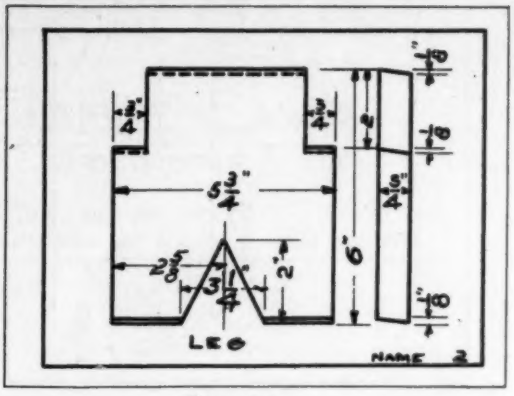


FIG. 6

Job Sheet No. 3

The Job: Make a Working Drawing of the Complete Stool. Show a front and an end view.

Follow the steps outlined.

1. Lay out the Sheet.

Draw the border lines on an 11 by 15-in. sheet of drawing paper, as was done for Jobs 1 and 2.

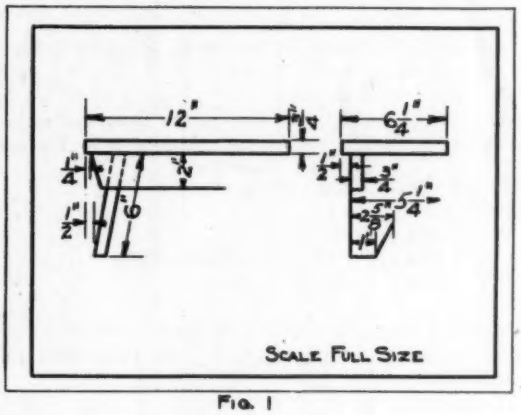


FIG. 1

2. Draw the Horizontal Lines.

The first one is to be drawn 3½ in. above the bottom border line; and the next one, 6¾ in. from the first. The two lines are the base line and top line of the finished drawing. (See Fig 2.) Study the drawing of the finished project and put in the rest of the horizontal lines required to finish your drawing.

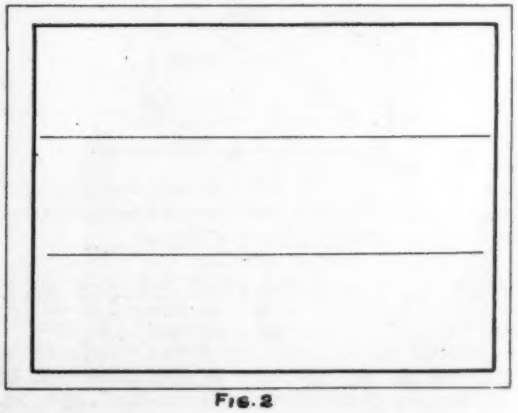


FIG. 2

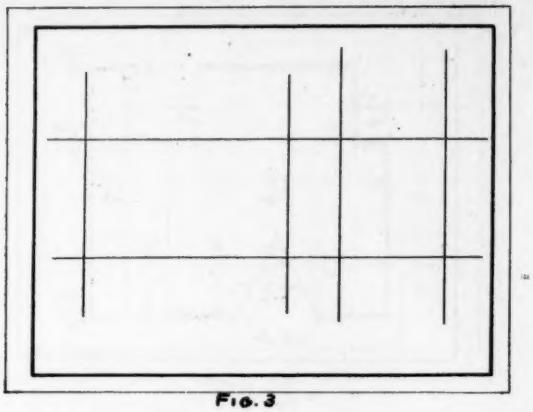


FIG. 3

3. Draw the Vertical Lines.

The first one is to be 1½ in. from the left-hand border line; the second one 12 in. from the first; the third, 1½ in. from the second, and the fourth, 6¼ in. from the third. The lines drawn are shown in Figure 3. Study the drawing of the finished project and put in the rest of the vertical lines required to finish your drawing.

4. Draw the Slant Lines.

5. Darken the Lines.

6. Put on the Dimensions.

All necessary dimensions are shown in Figure 1. Be sure to place them as shown.

7. Put on the Lettering.

Draw the lettering guide lines in the same way as in the other two job sheets. The title of this drawing is "Footstool."

Job Sheet No. 4

The Job: Make a Small Stool.

Materials:

1 pc. ¾ x 6¼ x 12	}	Finished Sizes
2 pc. ¾ x 5¼ x 6		
2 pc. ¾ x 2 x 11½		

Tools:

Pencils; ruler; try-square; backsaw; smoothing plane; hammer; screw driver; brace; 3/16-in. twist drill; chisel; and T bevel.

1. Square up the Stock.

Square up five pieces of stock for the top, two legs, and two rails.

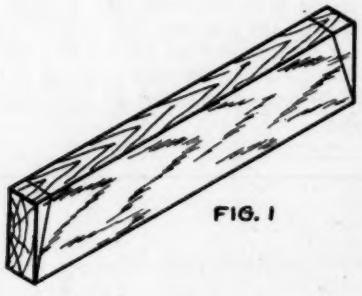


FIG. 1

2. Ends of Rails.

Lay off ½ in. on each end of the rails and draw a line as shown in Figure 1. Then place each piece on the bench hook and saw off the end wedges with a backsaw.

3. Taper Both Ends of each Leg.

Set the T bevel to the proper slant, as shown in your drawing of the leg. Lay off the slant on each end of the leg and plane the bevel off with a smoothing plane.

4. Cut the Legs.

Lay out the cuts into which the rails are to fit, marking them as shown in Figure 3. Cut out the pieces with the backsaw. When drawing the line at *a* use the T bevel set at the same slant as for the ends. Next, lay out the end as shown in Figure 3, and saw out the piece with the backsaw. A different design, as shown by the suggestive designs, also may be used.

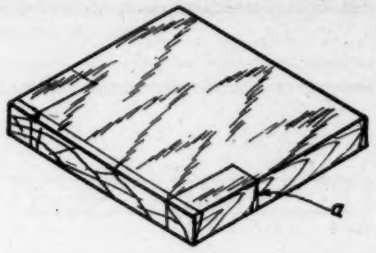


FIG. 2

5. Sandpaper all Parts.

6. Nail on the Rails.

Make a mark on each bottom side of the rails ¾ in. from the end. Adjust the leg in position and mark with a pencil. Now start the 6d finishing nails in the rails, put glue on the legs at the joint and nail them in place. Set the nails.

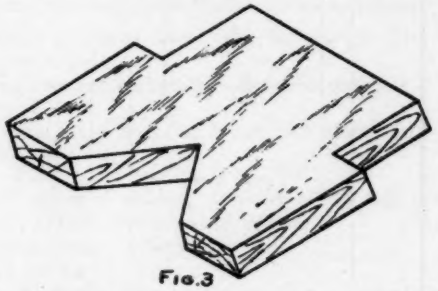


FIG. 3

7. Nail on the Top.

Set the top on carefully and mark it so that the projection is even all the way around. Start the nails, put glue on the top of the rails and legs, and nail the top on. Set the nails.

8. Putty.

Put putty, colored to suit the finish, in all nail holes.

9. Put on the Finish.

You may choose between lacquer, shellac, or enamel. Follow the directions on the can from which the finish comes.

TABLE LAMP IN "ART MODERNE" STYLE

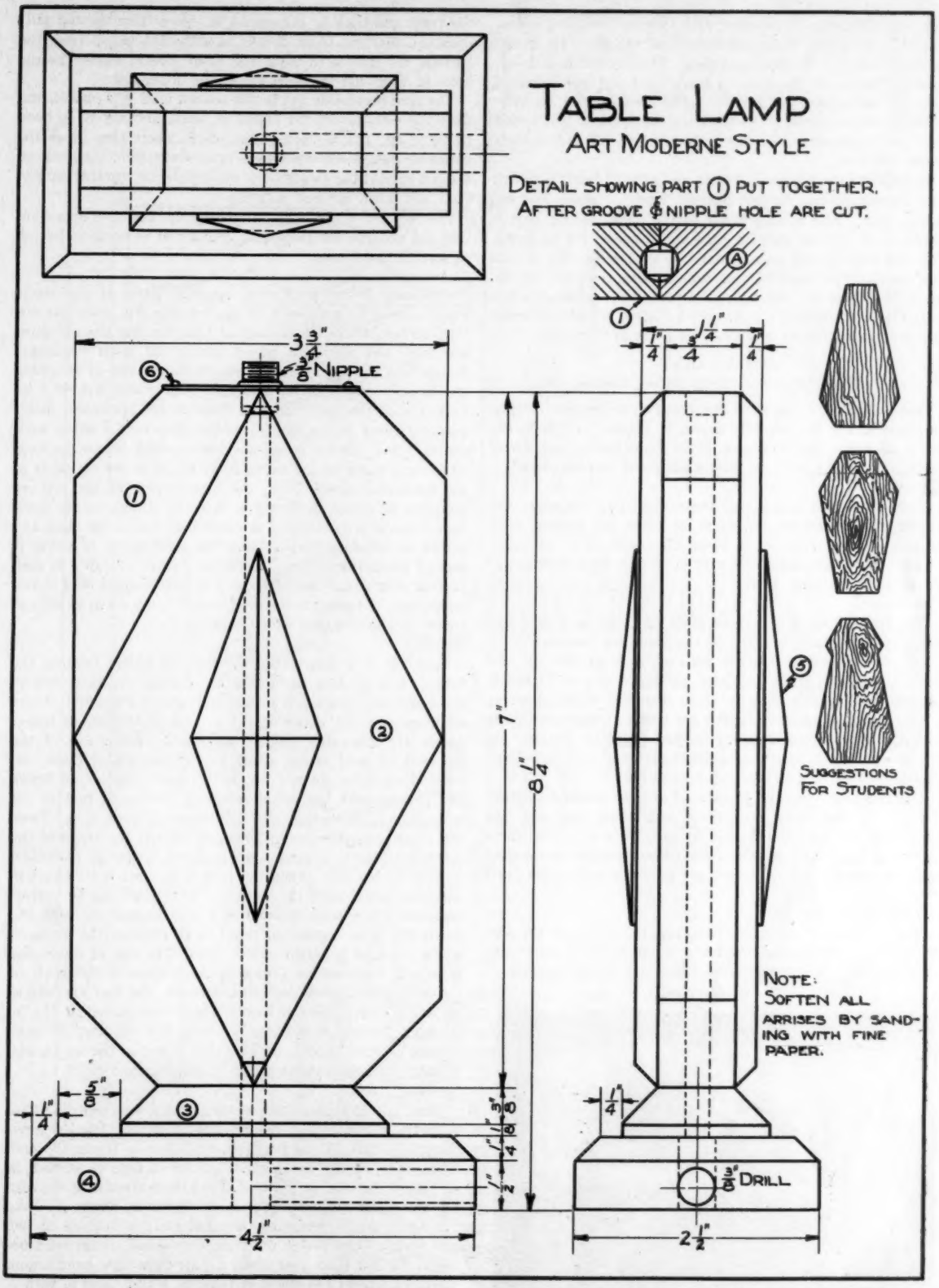
E. W. Manzer, Supervisor, Manual Arts,
Bronxville, New York

Modernistic Art has become a part of this period. Although it is reported, from reliable sources, that it is *not going over* in the larger pieces, it is finding much favor in the smaller pieces, such as the lamp, book ends, magazine holders, and bookshelves.

The project of the lamp has much in its favor, because it lends itself to many forms of individual design on the part of the student, it aids in the teaching of new tool processes and to the reviewing of the old, it introduces the problem of electrical connections, and furthermore, in the shape shown herewith, it is *new and up-to-date*.

When the student chooses this project from a bulletin board of project suggestions, he is given a few of the important dimensions needed for a start. Other suggestions are given him to stimulate his *creative imagination* and thus provide for that important objective — *creative effort*. To copy a given design will not afford the student the opportunity of *putting his own ideas into concrete form*.

There are several problems that arise in the construction of this project. One is the boring of the ⅜-in. hole for the nipple. (See detail A.) Another is the cutting of the groove for the wire to pass from the top to the bottom of the lamp. Several good suggestions have been advanced by students who have



made a lamp similar to the one shown. One student suggested this: "After part 1 has been cut in two parts and the edges have been planed so as to make a good butt joint, clamp the two pieces together tightly in a vise or with a clamp, and bore the hole with a 3/8-in. bit. To get the proper depth use a bit stop." When such directions come from a student, we can be assured that he has learned more than he would have, had the direction come directly from the instructor. This is an example of teacher guidance and not teacher direction. The groove for the cord proved a little more perplexing, perhaps due to the

lack of sufficient knowledge with which to think. This proved to be a case where the instructor was given an opportunity to teach a machine operation. The student had developed a "feeling of the need to know" and the psychological time for instruction had arrived. Other problems of an individual nature will arise with the individual projects. It is hoped that the "pupil-project-teacher" combination will aid in their proper solution.

In finishing the project if a stain and varnish job is planned, it is considered best to use different kinds of wood. For example, part 1 can be mahogany, part 2 black walnut, part 5 maple. If it is to be painted, pine may be used for all parts. The diamond-shaped ornamentation can be bought, as can also some carved molding for ornamenting the base of the lamp. If this is not desirable, the base may be ornamented with a bead or molding cut on with a shaper, in order to make this project worthy of a respectable place in the home.

ROMAN SEAT

L. F. Hyatt, McKinley High School, Canton, Ohio

One of the most useful of the inexpensive pieces of woven furniture is the Roman Seat shown in Figure 1. It is handy in the bedroom, the library, or in the living room. It is strong and durable and sure to be used wherever it may be placed.

Materials

The seat, which is made of brown fiber cord, requires 3¼ lb. of ⅛-in. round weaver, ¼ lb. of ¼-in. flat weaver, 1 lb. of wire staking, 15½ ft. of ⅜-in. reed, and 16 ft. of ⅞-in. or 1-in. dowel rod. This seat may be woven with reed at approximately the same price.

The Frame

The frame, Figure 2, may be made of ⅞-in. or 1-in. dowel rod. Cut two pieces of each of the following lengths: 20½, 18½, 14, and 12 in. On the ends of each of the 20- and 14-in. pieces, cut a half-lap joint, as shown at *a* in Figure 2. Care should be taken that not more than half of the diameter of the dowel be removed. Holes are bored through the joints to avoid splitting when nailing the top frame to the legs. On one of the 12-in. pieces, 15 holes, equally spaced, just large enough to receive the stakes, should be bored.

Cut two pieces each of ⅜-in. reed of the following lengths: 4 ft., 2 ft., and 22 in. Soak these just before they are used until they are pliable. One end of each piece is cut so as to taper out in a length of 1 in. Bore holes through the legs just large enough for the nails that are used for nailing the horizontal dowels in place.

Assembling the Frame

Study Figure 2 carefully. First nail the frame to the legs by driving nails through the holes in the half-lap joints into the legs. Next, nail the 18½-in. horizontal dowels in place in the front and back of the seat, 4 in. down from the top rail; then nail the two 12-in. dowels in place 5⅝ in. up from the bottom. Be careful to place the 12-in. dowel, which has the holes in it, so that the holes are on the upper side.

FIG. 1

The reed previously cut is now soaked until it is pliable, and then the 4-ft. pieces are nailed in place, starting at *b*, bend to shape and nail at each of the places where they touch the frame or legs. When other ends again come to *b*, cut them on a slope so that the two ends of each piece fit together snugly, then nail down the end securely.

Pieces *c* and *d* are next nailed in place, and it is important that the ends be cut sloping to enable the weaving to be put in smooth and even.

Strapping

Strapping is the process of covering parts of the frame which cannot be covered with the winding. The parts are the four corners where the horizontal bars forming the top joins the legs, and the eight places where the lower horizontal dowels join the legs. Figure 3 shows the method of strapping the lower dowels. Cut six pieces of ⅛-in. round weaver 5 in. long. Uncoil the ends and nail these to the horizontal dowel carrying them across the leg and nailing to the other horizontal dowel, always being sure that enough straps are used to cover a space on the leg equal in width to the diameter of the horizontal dowel. Next, the four corners on the top are strapped as shown in Figure 4. Nail the strands to the horizontal dowel at *x*. Strand *1* is carried up and to the right and nailed to dowel *y*, strap *2* from the *other* group of straps is carried up and over *1* and nailed to dowel *z*. Strap *3* is then carried over *2* and nailed to *y*, *4* is next carried over *3* and nailed to *z*, the other remaining strands being taken in turn as shown in Figure 4, and nailed in place.

Winding

Winding is a means of covering the dowel forming the frame. This is done by nailing the end of the fiber cord to the dowel and carrying it around and around the dowel. Pieces of fiber cord not exceeding 15 ft. are preferable, as longer pieces are somewhat difficult to handle. When one of the pieces is all used except about 8 in., take another piece, untwist the end for about 2 in. On the under side of the dowel, and parallel with the dowel, wind this untwisted part of the new strand underneath the old strand, Figure 5, A. Twist the old strand underneath now and untwist the end and use the new strand as a winder and continue. Cover all horizontal dowels in this way. When the reed is reached it is wound in with the dowel until the strand of fiber cord can be carried underneath the reed. Carry this strand around the reed and dowel the same number of times at all eight of the places at which the reed is nailed to the frame. The end of the strand is usually fastened as shown at A3, Figure 5. After all of the horizontal dowels have been wound, the legs are wound up to the two horizontal dowels which were nailed in 5½ in. up from the end of the legs. To start this winding, the ends are uncoiled for about 1 in. This part is laid on the leg parallel with it and wound in, as shown at A2, Figure 5.

Inserting Stakes

Next, cut 15 stakes (this material has a wire center) 46 in. long. Dip the ends into glue and insert in the 15 holes previously bored in one of the horizontal dowels across the end. Allow these to dry overnight. Cut two strands of weaver 38 in. long to be used as the wale. Fold these strands in the center and place around dowel *a*, as shown in Figure 5. Take the strand on the left each time and carry it in front of two and back of two stakes until the right-hand strand rests between the last stake and dowel *l*. Carry the right-hand strand marked *1* around the dowel in front of *k* and *j* and in with *2*. Carry strand *4* in front of *i* and *j*, back of *k* and *l*, around in front of *l* and *k* and in with strand *3*. Cut all ends off just long enough that they will not slip through between the stakes.

Weaving

Cut a piece of ¼-in. flat weaver, place it behind the dowel on the left and carry it in front of one and back of one stake,

ROMAN SEAT

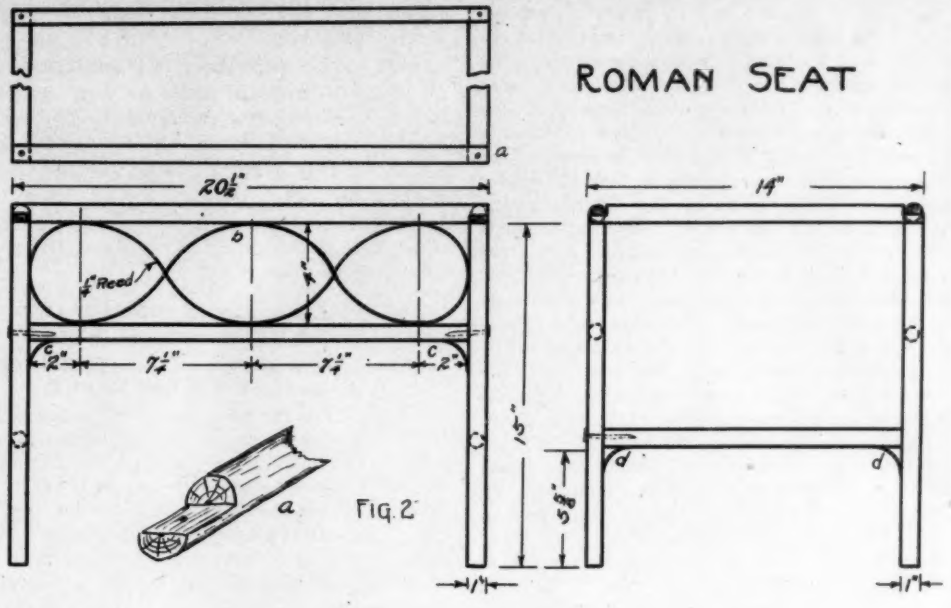


Fig. 2

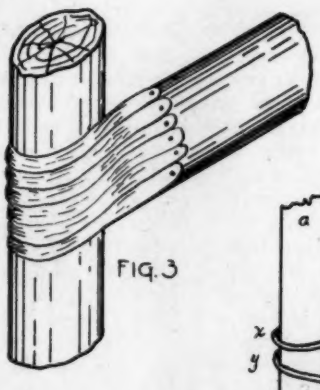
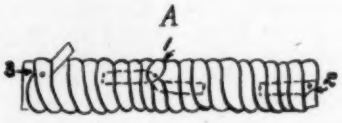


Fig. 3



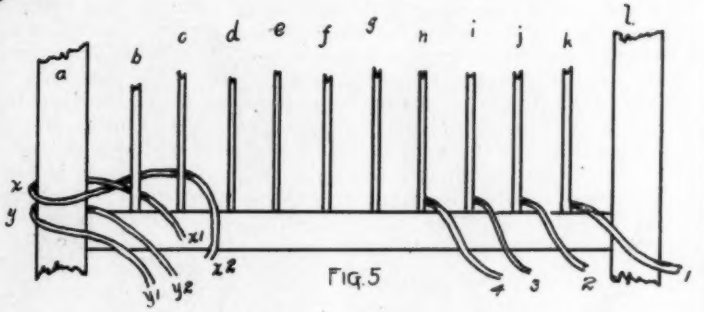


Fig. 5

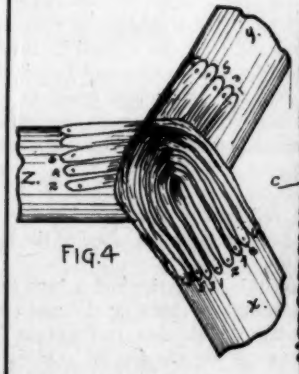


Fig. 4

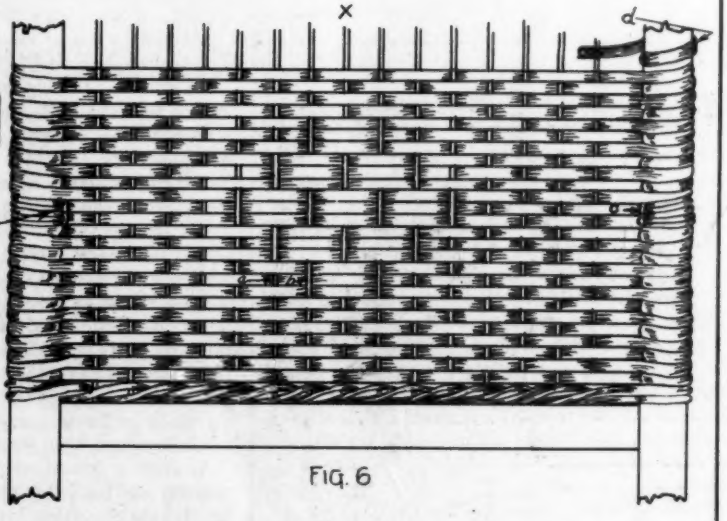


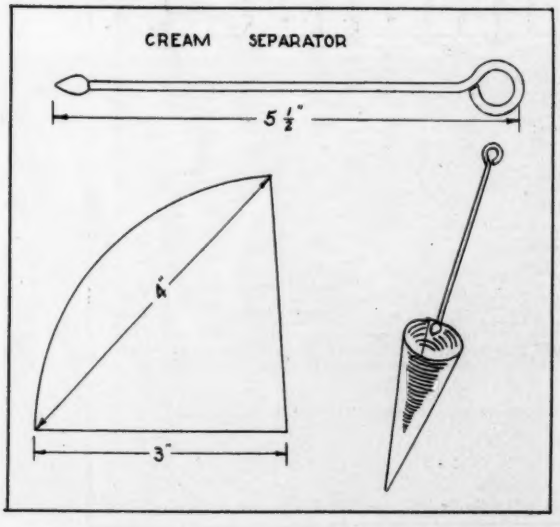
Fig. 6

in front of one and back of one, etc. Carry it around the dowel, as shown at *d*, Figure 6, and continue the over and under weaver in this manner eight times across. Cut a piece of staking 14 in. long and wind it in with the leg up to the point where the strapping was done and where it is found necessary, use this wire to carry the weaver around, instead of the leg. After the dowel is passed the stakes it is wound in with the leg until it is needed to pass over the corner at the top. To make the pattern, it is necessary to have the weaver go over stake marked *x* three times. The eighth time the weaver naturally goes over this weaver; the ninth time it is necessary to go under two stakes *a* and b, Figure 6, to make the weaver go over stake *x;* the third strand naturally goes over stake *x* again. The next three times the weaver must cross on top of the first stake at the right and first stake at the left of stake *x*. It is necessary to carry the middle weaver of these three strands under *two* as before. The next three times across, the weavers must cross over *x* and the second stake to the right and second stake to the left at *c*, Figure 6. Where the front horizontal dowel is nailed to the leg, it will be found necessary to carry the weaver around the piece of wire staking instead of the leg. This must be done twice or until one can carry the weaver around the leg *c*, Figure 6, then continue the weaving. Complete the diamond shown in Figure 6 and weave four times across above the diamond. Next weave in another wale. From the wale to the same point on the other end of the seat the ⅛-in. round weaver is used. Carry this weaver around the wire instead of the dowel in going over corners where the top and legs are joined. As soon as it is possible, carry the weaver around the horizontal dowel winding the end of the stake just used, in with the top dowel. Continue the weaving across the top. Insert another piece of stake before it is necessary to pass the corners on the other end of the stool and weave the second end exactly the same as the one just completed, only it is woven from the top of the stool *down* to the horizontal dowel across the end. When the dowel is reached on the end and the wale is woven in, the finishing off is done with the stakes. Starting on the left the first stake is carried in front of one stake and back of one; the stake is carried in front of one and back of one, until all of the stakes are used. Each stake is then nailed to the horizontal dowel. This completes the weaving. The stool should then be sized with a very thin solution of casine glue, after which it may be finished as desired.

CREAM SEPARATOR

Dan H. Ohlinger, Detroit, Michigan

This little article will help the cook get cream and only cream out of the milk bottle and will furnish the household-mechanics pupil with a problem using a scrap of bright tin and a piece of wire.



Steps in the procedure:

1. Cut out the shape shown in the illustration.

2. Form the cone and solder the joint, using a ⅛-in. lap seam tapering to nothing at the point of the cone.

Note: Test the diameter of the cone in a milk bottle.

3. Cut a piece of 3/32-in. wire about 6 in. long and form an eye at one end.

4. Flatten the other of the wire and solder it to the inside of the cone, so that the handle stands straight up, parallel to the axis of the cone.

TYPICAL JOB SHEET FOR THE AUTO SHOP

Ray F. Kuns, Cincinnati, Ohio

Testing the Alignment of Connecting Rod and Piston Assembly in Ford Model T

The motion of the lower part of the connecting rod is one of rotation, while the motion of the upper end is largely reciprocating. The motion of the piston pin is oscillating. This combination of motions means that a certain definite limit must be obtained between the moving parts in order to prevent undue wear. There are two things which may happen to a connecting rod to destroy proper alignment. One of these is the bending of the connecting rod and the other is the twisting of the connecting rod.

If a connecting rod is bent, the upper end will be thrown to the side and the piston pin will be put out of alignment with reference to the crankshaft. That is, one end of it will be closer to the center axis of the crankshaft than the other end. This means, of course, that the piston will likewise be thrown out of alignment, and instead of traveling freely in the cylinder, will bear on the lower part of the skirt on one side and on the ring lands on the other side. This, of course, will induce rapid cylinder and piston wear.

If the connecting rod is twisted, the piston pin is placed in a different plane from the axis of the crankshaft so that a rocking motion is imparted to the piston. This creates a very disagreeable piston slap and induces very rapid wear.

The amount of twist or bend in a rod, be it ever so slight, is certain to cause trouble.

There is considerable mathematics involved in the theory of connecting-rod alignment. Any mechanic should be able to grasp the principles however, and be able to correct any trouble. The procedure which follows, is for a rod which has been twisted at one point and badly bent at another. The amount of twist and bend has been exaggerated to show the results of these two forms of misalignment.

Another form of misalignment, which is not so likely to be encountered, is an offset rod. That is, if the rod were bent to the side near the big end and then was aligned by bending it back near the small end, the small end would be offset with reference to the large end and this might result in trouble owing to the fact that the clearance between the upper end of the piston-pin boss and the connecting rod was not sufficient to care for this bending.

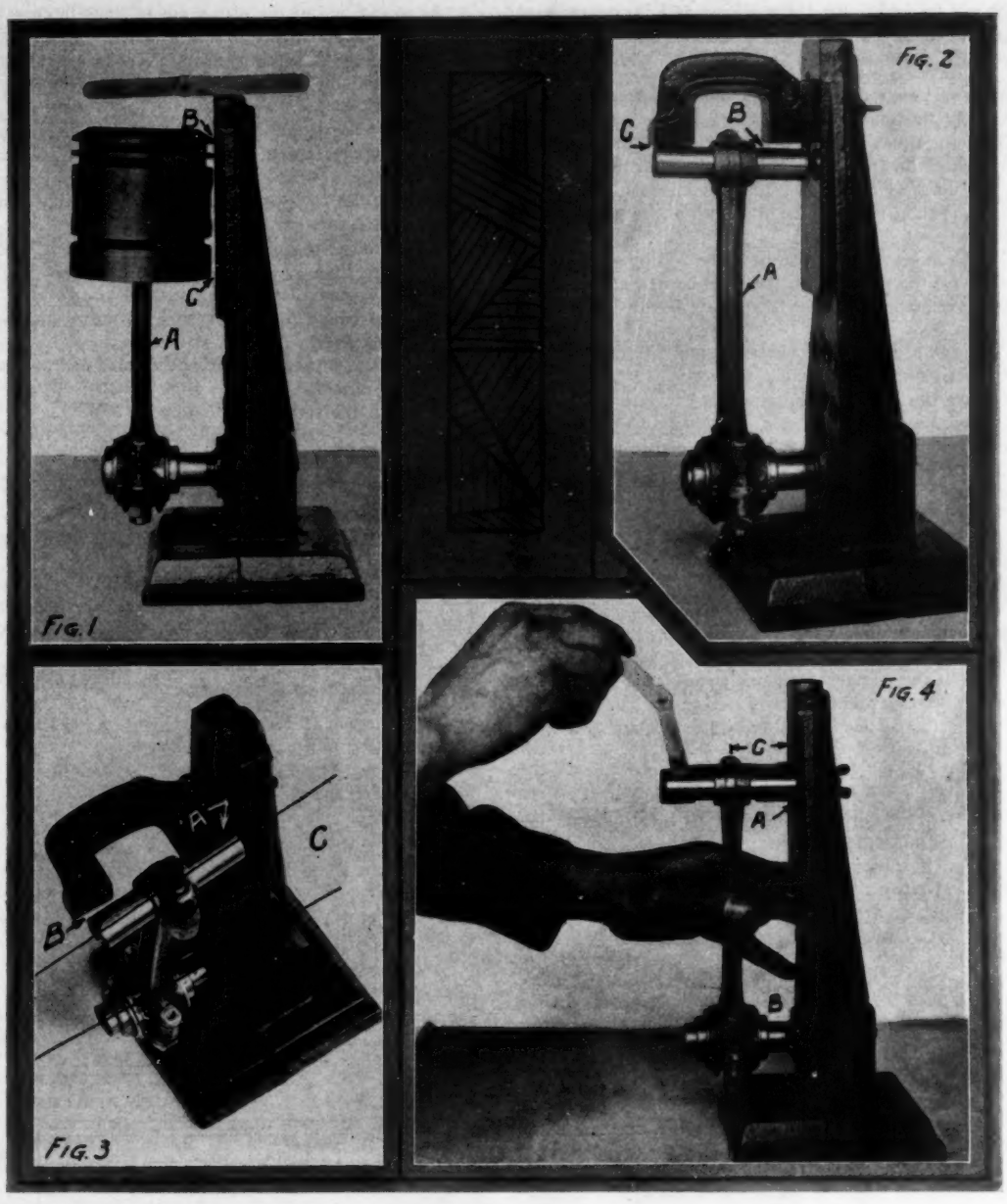
Procedure A:

1. If the connecting rod and piston assembly are to be aligned, the first step is to place it on the arbor of the aligning jig, as shown in Figure 1.

2. It will be noted that this connecting rod is bent near the central part, at A. This results in throwing the ring lands of the piston against the fixture at the top, as shown at B, and the skirt away from the face of the aligning jig, as shown at C.

3. In order to correct this misalignment, place a heavy monkey wrench on the connecting rod just above the bend at A, exert a downward pressure on the end of the handle to spring and bend the connecting rod back slightly.

4. Slip the piston back against the face of the jig and test again.



5. If it is found that the face of the piston is aligned with the face of the jig, touching equally at top and bottom, the next step is to reverse the assembly on the arbor, testing the other side to see whether it also aligns.

6. Continue testing forth and back until there is scarcely any clearance at the ring lands on each side of the piston.

Note: The Ford piston is given a slight taper, that is, it is slightly larger at the bottom than it is at the top. If the piston has been manufactured according to specifications, it will be found that there is a clearance of .005 in. on each side of it at the point B, since the piston is .010 in. smaller at the top than at the bottom.

The above steps take care of the testing of the connecting rod and piston assembly for bend in the rod. The following steps will describe the method of checking the piston assembly for twist in the rod.

1. Check up the piston as mentioned above for bend. Having found and corrected any misalignment due to bend, proceed as follows:

2. Revolve the piston on the piston pin toward one side as far as it will go. In this position it should have exactly the same clearance at the top, that is, .005 in., as it did when standing vertical.

3. Revolve it the other way as far as it will go, that is, until the skirt strikes the connecting rod.

4. Test again. The skirt should be in contact with the face of the jig, and .005 in. should show at the top ring land.

Note: If any twist is evident in the rod, it will be found that the piston will not remain in alignment when thus revolved, that is, there may be more or less than .005 in. at the top land. The bend may be so extreme that the top land is thrown against the face of the jig and the skirt of the piston is thrown away from the face of the jig.

5. Use the large monkey wrench and grasp the connecting rod just under the piston skirt. Twist it to the side indicated by the test.

6. Recheck as suggested above, revolving the piston first to one side and then to the other. When the twist has been cor-

rected it will be found that there will be .005 in. clearance at the top land in any of the three positions, that is, vertical, left, or right.

Aligning Connecting-Rod and Piston-Pin Assembly

Procedure B:

1. The results of a bend in a connecting rod are shown in Figure 2. The bend appears at A. This results in throwing one end of the pin away from the fixture, mounted on the face of the jig, as shown at B, while the other end of the pin is touching the fixture, as shown at C.
2. Use the monkey wrench to bend the rod by grasping the rod just above the point where the bend occurs, at A.
3. Recheck by moving the fixture at the top of the pin downward.
4. Continue bending and checking until the piston pin touches the fixture evenly.
5. Remove the rod from the arbor and reverse it.
6. Recheck the pin alignment. If it is found to be the same as before being reversed, the job may be considered finished, so far as the bend in the rod is concerned.

Note: Aside from the bend in a rod is the possibility of twist. The effect of a twisted rod is shown in Figure 3, where it will be noted that the piston pin strikes the fixture at A, but has considerable clearance at the point marked B. This misalignment is due entirely to twist.

7. Correct this twist by grasping the connecting rod between the jaws of a large monkey wrench just under the piston pin.
8. Twist the rod to the side until it aligns with the face of the fixture on the aligning jig, both ends of the pin striking the face at the same time.
9. Reverse the connecting rod on the fixture and test again for alignment.
10. If found to be correct, make another test for bend as suggested in the foregoing steps 2 to 5.

Note: If further work is to be done to correct bend, then the final check must be with reference to twist. The experienced workman knows that bending or twisting of a rod is likely to have other than the desired effect, so he is always certain to check and recheck until he knows the rod is absolutely correct, so far as twist or bend is concerned.

Checking Connecting Rod for Offset

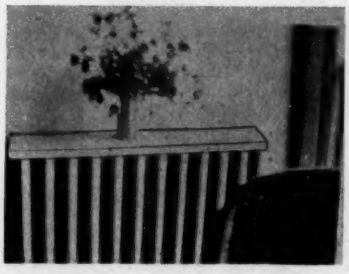
Procedure C:

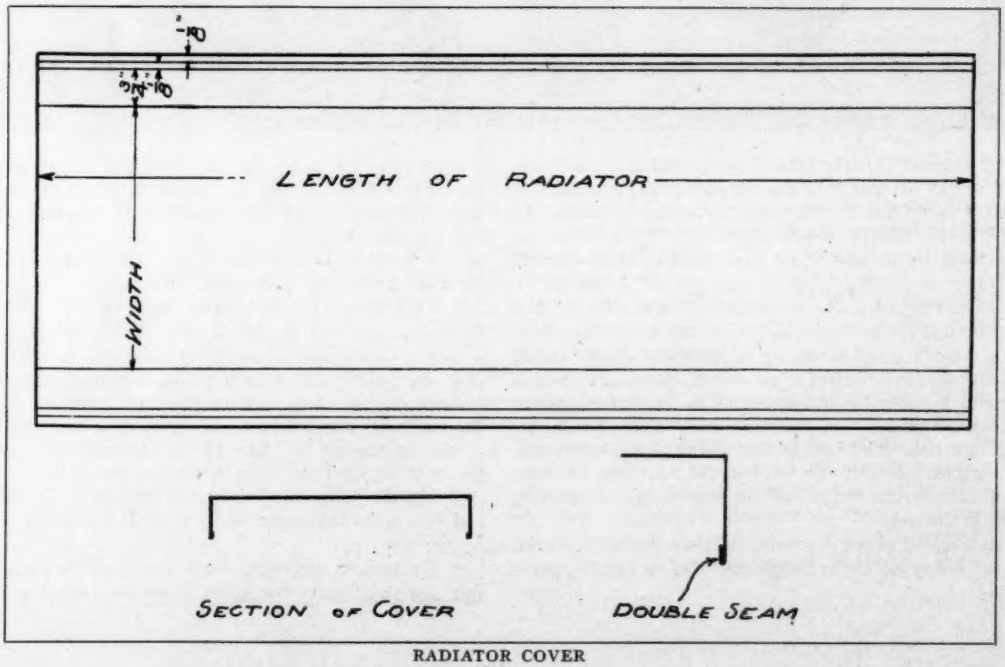
1. Assemble the connecting rod with the pin and mount on the arbor, as shown in Figure 4.
2. Allow one end of the piston pin to come in contact with the face of the testing jig, as shown at A.
3. Measure the distance from the lower face of the aligning jig to the center of the connecting-rod bolt at B. Record this measurement.
4. Measure the distance from the center of the clamp-screw bolt to the upper face of the aligning jig at C. Record this measurement.
5. Reverse the connecting rod and pin assembly and measure the same points again.
6. Compare the recorded measurements. If it is found that there is more than 7/32-in. variation, the offset in the rod should be corrected. To do this, proceed as follows:
1. Use the heavy monkey wrench to spring the rod just above the big end.
2. Using the same means, spring the small end of the rod in the opposite direction.
3. Recheck the rod on the fixture.
4. Repeat the bending and checking until the offset of the rod falls within the limits of 1/32 in.
5. Check the rod for bend and twist after removing offset.

RADIATOR COVER

Fred W. Megow, Thomas Williams Junior High School, Wyncote, Pennsylvania

To save the walls and ceilings of a house from becoming streaked with dirt above the radiator, the author has devised a simple radiator cover which can be made of galvanized iron. The length and width will, of course, depend upon the size of the radiator. It may be finished with lacquer to harmonize with the color scheme in the room.





RADIATOR COVER

DECEMBER MEETING OF VOCATIONAL EDUCATION SOCIETY OF BOSTON

The December meeting of the Vocationl Education Society of Boston was held Saturday, December 14, at the Hotel Westminster, Boston, Mass. Thirteen persons were elected to active membership in the society.

The principal speaker was Mr. Dallas, who is in charge of the rehabilitation work for the State of Massachusetts. Mr. Dallas gave an outline of the history of the work of rehabilitation from the federal board down to the state department. Massachusetts started its training department for those injured in industrial accidents in 1918, thus becoming the pioneer state in rehabilitation work. One of the most difficult problems, according to Mr. Dallas, was to get the victim of an accident in the proper frame of mind to receive training. Many times, through ignorance of the compensation law, the victim expects to receive considerable remuneration, and failure to receive the anticipated amount, leaves him in a disgruntled frame of mind. Many times an injured person is well along in years, and it is hard to convince him that it is possible for him to learn a new occupation in which to earn a living. In his experience, Mr. Dallas found that age is not a serious handicap in retraining an injured person, provided there is a serious desire to be trained. The length of the training period is about one year, but it is intensive during the period. A maintenance fund is provided, from which a weekly stipend may be drawn to supplement the small salary received while the injured person is being trained. Frequently a scheme of training is worked out with the cooperation of the continuation and vocational schools. When trained along special lines, many of these workmen become very proficient. In conclusion, Mr. Dallas urged teachers of handicapped persons to instill the idea that each person has a chance to earn an honest living. Even though such a person may no longer be able to do the work of a laborer, he can be trained as a skilled worker in some industry.—*Louis A. Van Ham*

MANUAL-ARTS CONFERENCE

The twentieth annual conference of the industrial-arts teachers of the Mississippi Valley states, was held December 12–14, at Peoria, Ill. The anniversary feature of the program was the dinner, at which the men taking part in the first conference were present at the speaker's table. Those composing the original conference group were Mr. Charles A. Bennett, of Peoria, Mr. C. H. Bailey, of the Iowa Teachers' College, Dr. William T. Bawden and Mr. F. D. Crawshaw, of Peoria, Prof. M. L. Laubach, of the Indiana Teachers' College, Prof. R. W. Selvidge, of the University of Missouri, Prof. F. C. Whitcomb, of Miami University, and Prof. A. C. Newell, of the Illinois Normal University. Mr. Bennett read the call for the first meeting, and the report of the proceedings was presented by Dr. Bawden. A summary of events in the history of industrial education, leading up to the conference, was presented in an interesting paper by Mr. Bennett. The evening was given over to a recital of the achievements of the conference during the past twenty years, and to reminiscences of earlier meetings. Mr. Bennett was presented with a gift from this year's membership.

Mention was made that the members of the first conference at Peoria, in November, 1909, were Mr. L. R. Bacon, Mr. C. H. Bailey, Dr. W. T. Bawden, Mr. C. A. Bennett, Mr. L. H. Burch, Mr. G. F. Buxton, Mr. F. D. Crawshaw, Mr. M. L. Laubach, Mr. O. L. McMurry, Mr. Walter Sargent, Mr. R. W. Selvidge, and Mr. L. W. Wahlstrom.

At the 1929 conference, topics covering a wide range of importance and interest were presented. Dr. Homer J. Smith, of the University of Minnesota, discussed "Methods of Testing the Results of Instruction in Shopwork; Mr. H. W. Schmidt, of the Wisconsin State Education Department, talked on "Testing Programs for the High Schools," pointing to the great need for objective tests in shopwork and the folly of using poor tests; Professor Selvidge, of the University of Missouri, and Professor Frycklund, of the State Teachers' College, Kearney, Nebr., presented papers on "Topics in Educational Psychology for Prospective Teachers of Shopwork and Drafting." Other speakers on the program were Mr. C. H. Bailey, Mr. M. L. Laubach, Mr. W. H. Stone, Mr. A. C. Newell, Prof. DeWitt Hunt, Mr. D. M. Schweickhard, Mr. W. E. Roberts, and Prof. F. C. Whitcomb. Among the topics discussed were "Problems of the General Shop"; "Problems in Shop Planning and Equipment for the Prospective Teacher"; "Reorganization of the Methods Demanded by Larger Classes."—*A. B. Mays.*

THE MEETING OF THE INDUSTRIAL-ARTS TEACHERS

The annual meeting of the industrial-arts and vocational teachers of Texas was held November 28–30, at Dallas. At the general sessions, Dr. J. C. Wright, Prof. A. W. Heckman, Dr. C. A. Prosser, and Dr. T. O. Walton were the speakers.

At the Friday session, a number of sectional meetings were held for the discussion of vocational agriculture, commercial, home economics, industrial arts, and trade subjects. The last three met in a joint session, with talks given by Dr. J. C. Wright, Mrs. Anna L. Burdick, and others.

At the industrial-arts session, Prof. E. L. Williams gave a forceful argument for the industrial arts as a valuable educational asset in the junior and senior high schools. Mr. N. S. Hunsdon, state supervisor, reported on the growth and accrediting of the industrial-arts subjects during the year.

At the trades-and-industries session, the teachers discussed the problem of coordination, under the leadership of Mr. M. C. Stone, of Arlington. Mr. R. L. Martin, of Fort Worth, took the topic, "Organizing Evening Trade-Extension Classes," while Miss Zelda Ramsey, of Arlington, discussed "Commercial Training in Its Relation to the Vocational Field."

All the practical-arts sections met in a joint session at the vocational breakfast on Saturday morning, when Dr. Prosser, Dr. Wright, Mrs. Burdick, and Dr. Margaret Justin made short talks before the group.

The exhibits included a number of educational displays of interest to industrial-arts teachers. Four of these were equipment companies for shop activities, while the others were exhibits of educational publishing houses, and displays of the products of Texas schools along the lines of art, drawing, and shopwork. The Dallas day and evening schools had a large display of work in commercial art, drafting, design, pottery, clothing, sheet-metal work, machine-shop projects, cabinet-making, and welding. More than forty different types of classes were in regular operation in the Dallas evening school for the benefit of the visiting teachers. At the business session, the following officers were elected for several sections:

Industrial Education: President, Mr. C. Ray, Tyler; vice-president, Mr. Victor Randel, Huntsville.

Industrial Arts: President, Mr. Harry Gerbens, Port Arthur; vice-president, Mr. H. H. Wright, Houston.

Trades and Industries: President, Mr. G. H. Fern, College Station; vice-president, Mr. E. S. Blackburn, Corsicana.

Vocational: President, Miss Laura Murray, Austin; vice-president, Mr. W. H. Elam, Taylor; second vice-president, Miss Clara Tucher, Denton; third vice-president, Mr. J. J. Brown, Austin; secretary-treasurer, Miss Bernice Mallory, Austin.—*V. J. Smith.*

THE WASHINGTON COUNTY VOCATIONAL MEETING

The vocational society of Washington county, Pennsylvania, held a meeting on December 17, at Washington. Dr. Ben G. Graham, first associate superintendent of schools of Pittsburgh, in his talk, said that the trend of home-economics education is toward the practical. In the Pittsburgh schools, there have been innovations, which fifteen years ago, would have been considered a hardship. The trend at present is away from millinery teaching and greater emphasis on the handmade garment. Mr. Graham believes there is some question as to whether the science of cooking should be studied, or skill developed in the use of the can opener. It appears that girls in the higher grades are not so much interested in the home-economics work, since they can see no immediate need

for such work. However, a number of the senior girls are taking the work as an elective.

According to Mr. Graham, the tendency in industrial arts is toward the practical. There is considerable repairwork on articles which the pupils bring from their homes, while in the seventh, eighth, and ninth grades, the general-shop plan is emphasized. In the eleventh and twelfth grades of the senior high school there is a slight falling off, due to the fact that the work is not practicable.

Miss Mable B. Trilling, of Carnegie Institute of Technology, emphasized that development of skill in baking and sewing is not the main purpose of home-economics work, and pointed out that commercialization will not lead to appreciation.

Mr. Earl L. Bedell, of Detroit, Mich., talked on safety programs, stressing the need for prevention of accidents. Speaking on "Socialized Industry," Mr. Bedell cited six important points in connection with the movement. He emphasized particularly, that the young worker should be informed about labor and capital, and problems of management, division of labor, laws of supply and demand, and proper training.

Mr. L. H. Dennis, of the state education department, pointed to the fact that the trend of vocational education is on the upgrade. A number of new buildings for industrial and vocational work have been erected, a continuation school has been built in Reading, and efforts are being centered on obtaining larger appropriations for industrial and vocational education in the state.

Dr. G. D. Whitney, of the University of Pittsburgh, talked on "Individual Differences," pointing out that the vocational program is necessary to the development of good citizenship. —*George C. Donson.*

THE INDUSTRIAL-ARTS ASSOCIATION MEETS AT PITTSBURGH

The Industrial-Arts Association of Pittsburgh held a meeting on December 19, at the Hotel Henry. A total of 240 persons were in attendance. The exhibits were of a high grade and reflected much credit upon teacher and pupil. Mr. George C. Donson was in charge of the meeting.

Mr. L. H. Dennis, Harrisburg, in his talk, emphasized the high spots of a recent trip to England. He called attention to the democracy of the United States and to the opportunities enjoyed by the youth of the country.

Mr. Earl L. Bedell, of Detroit, Mich., talked on vocational guidance, pointing to the first course offered at the University of Chicago in 1914. He pointed out the fallacy of the "white collar" job and expressed the hope that every boy in the audience would become a good workman. Dr. Ben G. Graham, Dr. Whitney, and F. M. Leavitt, of Pittsburgh, gave some interesting remarks, after which Rosey Rosewell entertained the teachers for a half hour.

The next meeting will be held on January 16, at which time Chief Kerr will initiate the "yellow dogs."—*George C. Donson.*

DELAWARE INDUSTRIAL-ARTS TEACHERS HOLD MEETING

The industrial-arts section of the Delaware Teachers' Association held its annual meeting Nomeber 14–15, at Milford, Delaware.

The subject of "Newer Ideas and Objectives in Industrial Arts" was taken by Mr. A. B. Anderson, of Wilmington; Mr. John Shilling, Dover, gave a talk on "Past and Present Status of Industrial-Arts Work in Delaware"; Mr. Frank Hynson, Smyrna, led in a discussion on "School Repair and Replacement as a Shop Activity." An interesting discussion was aroused on the topic, "Why Should Schools of Two Hundred or More Pupils Have Some Type of Shop Activity?"

A resolution was adopted, indorsing some type of shopwork for schools of 200 or more pupils. A committee was appointed to investigate the conduct of industrial-arts programs in other states. The meeting closed with a business session and the election of officers.

Mr. W. I. Tawes, Claymont, was elected as president of the association for the next year.— *W. I. Tawes.*

THE TRADE-SCHOOL PRINCIPALS' MEETING AT NEW ORLEANS

The Trade-School Principals' Association held a meeting on December 5, at the Roosevelt Hotel, New Orleans, La., with President Urban G. Willis in charge.

A paper by Miss Elizabeth Fish, on "Problems of the Small Trade School for Girls," was read by Mr. G. B. Frazee. Mr. W. B. Kamprath, of Buffalo, N. Y., read a paper on "Securing Public Support for a Trade School," and a report on Productive Work in Trade Schools was presented by Mr. O. H. Turner, of the Ranken School of Mechanical Trades, St. Louis, Mo. Mr. Arthur B. Mays, of the University of Illinois, read a paper on "Training a Teacher of Mechanics."

The meeting closed with the election of offices for the year. Mr. O. H. Turner was elected president, and Mr. George B. Frazee, secretary, of the association. The members of the executive committee include Mr. George B. Frazee, Grand Rapids, Mich.; Mr. G. A. Burridge, Springfield, Mass.; Miss Florence Marshall, New York, N. Y.; Mr. Urban G. Willis, Chicago, Ill.; Mr. O. H. Turner, St. Louis, Mo.; Mr. O. D. Evans, Philadelphia, Pa.

PROGRAM FOR THE DEPARTMENT OF VOCATIONAL EDUCATION, N.E.A.

The Department of Vocational Education of the National Education Association will hold its annual meeting February 25–26, at Atlantic City, N. J. Mr. Wesley A. O'Leary, of Trenton, N. J., will act as presiding officer.

The session on Tuesday will open with an address on "Vocational Education for Women and Girls," by Miss Marion Van Liew, of the state education department, Albany, N. Y.; Mr. A. B. Meredith, state commissioner of education for Connecticut, will talk on the subject, "Public Education as Affecting the Adjustment of Youth to Life"; and Mr. C. K. Davis, of Miami, Ariz., will take for his subject, "Meeting the Educational Needs of a Mining District.

At the Wednesday session, Mr. Frank A. Cushman will preside. Mr. L. H. Dennis of the state education department of Pennsylvania, will talk on "The Spirit of the Master Craftsman"; Mr. B. W. Hartley, superintendent of schools of San Antonio, Tex., will discuss "Vocational Training as a Part of a City School Program"; and Mr. Edwin A. Lee of the University of California, will take for his topic, "The Shop Teacher as a Counselor."

FOURTH MEETING OF WISCONSIN ASSOCIATION FOR THE DISABLED

The fourth annual meeting of the Wisconsin Association for the Disabled was held January 23–24, at the Schroeder Hotel, Milwaukee. An excellent program was held on both days, including a visit to the Lapham Park School for Crippled Children.

The Association conducted a membership campaign during the month of December, in order to obtain funds for the maintenance of orthopedic clinics and incidental expenses. As increased facilities are provided, the association is widening the scope of its work in seeking out crippled children and ministering to their needs.

OSWEGO NORMAL BOYS ANNOUNCE ANNUAL DINNER

At a recent meeting in the Hotel Commodore, New York City, the plans were completed for the thirtieth annual dinner of the Oswego Normal Boys, to be held on March 1. Mr. Clarence D. Hanford, of the Stuyvesant High School, New York, is chairman of the committee in charge of reservations.

THE TEXAS HOME-ECONOMICS CONFERENCE

The annual state home-economics conference for Texas was held November 25–27, at Dallas, under the direction of Miss Lillian Peek, state supervisor.

Among the topics discussed was that of exchange classes with industrial-arts teachers. Outlines have been formed and experimental classes conducted where boys are taken into home-economics work for short units of instruction, and girls are given an equal amount of time to shop activities in the industrial arts. Miss Bess Heflin, chairman of the special investigating committee, was asked to continue her work for another year. Miss Maude Williams, of Fort Collins, Colo., was leader of the conference which discussed a study of the needs of pupils and of homemaking instruction based upon these needs.—*V. J. Smith.*